

Guide for Quantifying Post-treatment Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin

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Technical Note 437

University of Idaho
College of Natural Resources



Sagebrush Steppe
SageSTEP
Treatment Evaluation Project



Available Online at:

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Abstract

Invasive species and woodland encroachment have caused extensive changes in the fire regimes of sagebrush steppe over the past 150 years. Land managers and resource specialists of the Great Basin are increasingly required to implement vegetation treatments to maintain habitat, reduce fire risk and restore landscapes to a more desirable state. Often it is difficult to measure treatment effectiveness because gathering pre- and post-treatment data is time-consuming and costly. In two years of post-treatment sampling across six Great Basin states, researchers from the Sagebrush Steppe Treatment and Evaluation Project (SageSTEP) measured the vegetation response to prescribed fire, tree mastication and cutting, shrub mowing, and herbicide application. Treated plots were compared to untreated control plots. This *Guide for Quantifying Post-treatment Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin* assimilates the SageSTEP post-treatment vegetation and fuels data into an assessment tool that will help users better estimate post-treatment percent cover, stem density and fuel loadings. Designed similarly to the Natural Fuels Photo Series, produced by USDA Forest Service Fire and Environmental Research Applications (FERA) team, this Guide provides the necessary landscape-level inputs required by fire behavior and fire effects models and may also be used when building custom fuelbeds. Through the use of photographs and tables with the range of values for each vegetation type, users should be able to quickly appraise sites by fuel stratum. When used in conjunction with the pre-treatment *Guide for Quantifying Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin* (Stebbleton and Bunting 2009), this post-treatment Guide has the capability to aid users as they predict vegetation and fuel response to the various treatment applications, assess target conditions, set management objectives for restoration projects, choose treatments to meet objectives and determine treatment effectiveness.

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Introduction

SageSTEP (Sagebrush Steppe Treatment Evaluation Project) is an interdisciplinary, long-term study to evaluate the effects of various restoration treatments in sagebrush steppe communities of the Great Basin (McIver et al. 2010). Sagebrush steppe, characterized by dry, open expanses dominated by sagebrush plant communities, is one of the most threatened vegetation types in North America (Noss et al. 1995). Loss of sagebrush steppe is often attributed to shifting fire regimes as a result of non-native grass invasion, especially cheatgrass (*Bromus tectorum*), and pinyon pine (*Pinus edulis* and *Pinus monophylla*) and juniper (*Juniperus* spp.) encroachment (Pellant 1994, Miller and Tausch 2001).

SageSTEP was funded initially by the Joint Fire Science Program with ongoing support from the National Interagency Fire Center and the Bureau of Land Management. The project involves collaboration with five universities, six federal agencies, and one non-profit organization. The objective of SageSTEP is to identify abiotic and biotic thresholds that influence the sustainability of sagebrush steppe communities and provide information to managers, ranchers, and the general public to help restore sagebrush steppe to a healthier, more diverse ecosystem.

Cheatgrass has invaded nearly 25 million acres (10 million ha) of the Great Basin (Olsen 2008). Cheatgrass is able to gain a foothold in native plant communities by providing a continuous bed of fine fuel susceptible to fire at a time when it is most harmful to native perennials (Peters and Bunting 1994) because of its ability to germinate and establish before native

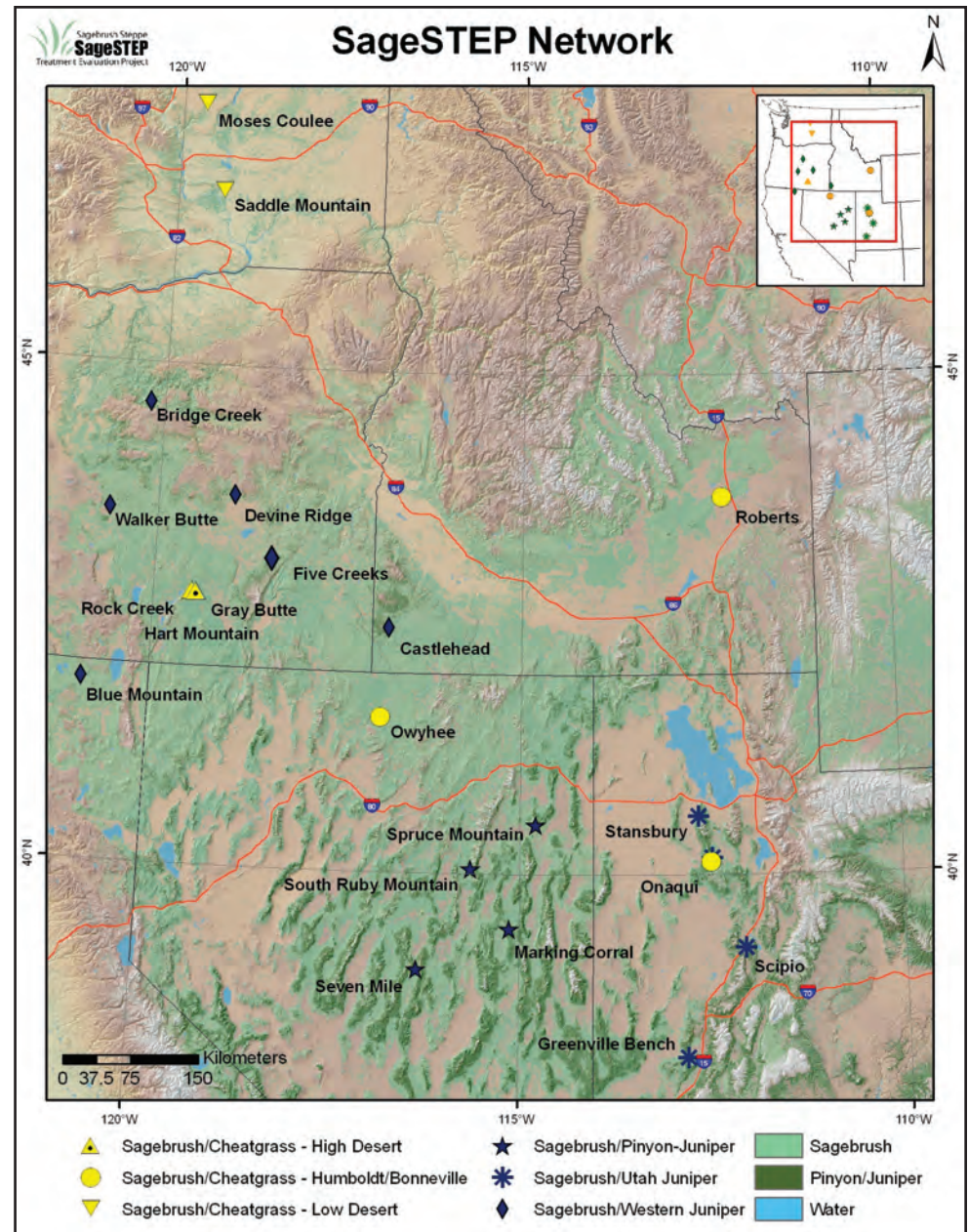


Figure 1. SageSTEP Site Map for reference with site names. Site-specific information is available at <http://www.sagestep.org/locations.html>.

perennial grasses (Bradford and Lauenroth 2006) and because it cures earlier in the growing season than perennials (Mutch 1967).

Cheatgrass dominance has shifted the mean fire return interval from several decades to 100+ years, in healthy Wyoming big sagebrush-dominated communities (Wright and Bailey 1982), to less than 10 years in many places (Whisenant 1990). Fire occurrence perpetuates cheatgrass expansion, quickly depletes the sagebrush seed bank, and converts native vegetation to an annual grassland (Whisenant 1990). This is the concern in the Sagebrush/Cheatgrass East and West locations (Figure 1). These will be referred to as the 'sagebrush sites' for the rest of the Guide.

Woodland encroachment by pinyon pine and juniper has caused a major shift in species assemblages and altered fire regimes of sagebrush steppe landscapes (McIver et al. 2010). The average fire return interval has shifted from 10–50 years, in healthy mountain big sagebrush-dominated communities, to more than 50 years (Miller et al. 1999, Miller and Tausch 2001). When fire does burn in these woodlands it is characterized by extreme fire behavior and results in more stand-replacing fire than in historic sagebrush communities. Native species recover slowly following high-intensity fires, allowing further invasion of exotics over large areas. This is the major concern in the Sagebrush/Pinyon-Juniper, Sagebrush/Utah Juniper, and Sagebrush/Western Juniper locations (Figure 1). These will be referred to as the 'woodland sites' for the rest of the Guide.

The *Guide for Quantifying Post-treatment Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin* was created using second-year post-treatment data collected by 5 field crews in 2008, 2009, and 2010. The SageSTEP network consist of 5 regional networks with 21 total sites (18 of which were used for this guide) spanning Washington, Oregon, California, Idaho, Nevada and Utah (Figure 1). Each site was a replicated, stand-alone experiment, however because of the common sampling design, data could be aggregated for regional representation.

Why is this Guide needed?

This Guide is the only SageSTEP publication to date summarizing the post-treatment vegetation and fuels data, across all 5 regions and 18 sites, into a usable tool for managers and other land stewards. Modeled after the Natural Fuels Photo Series (Ottmar et al. 2000), it allows users to quickly access percent cover, stem density and fuel loadings by fuel stratum (Ottmar et al. 2007). This information is often time-consuming and expensive to collect on a field site. The Guide increases efficiency by giving users pictures coupled with data to make predictions based on ocular estimates and/or limited field sampling. Fuels information gathered from this Guide may be used when creating custom fuelbeds and in a variety of modeling applications for treated sites. When used in conjunction with the pre-treatment *Guide for Quantifying Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin* (Stebbleton and Bunting 2009), the post-treatment Guide has the capability to predict vegetation and fuel response to the various treatment applications, assess target conditions, set management objectives for restoration projects, choose the proper treatments to meet objectives and determine treatment effectiveness.

Methods

SageSTEP employed a randomized design that was implemented across all 18 sites used to create this guide, including 1140 subplots, within the Great Basin (Figure 1). At each site, subplots were established along a systematic grid with a minimum distance of 164 ft (50 m) between the center of each subplot. Sagebrush sites were at least 200 acres (80.9 ha) with 160 subplots; woodland sites ranged from 25–50 acres (10.1–20.2 ha) with 60 subplots. Each subplot was 98.4 x 108.3 ft (30 x 33 m) with 5 vegetation transects and 1 fuels transect (Figure 2). The two fuels transects, represented in Figure 2, were alternated for the three years of sampling. Transects ran parallel to the 108.3 ft (33 m) length allowing a 4.9 ft (1.5 m) buffer on either end.

A common measurement protocol was used across all sites. Refer to Table 1 for specific methods and transects used for each reported variable by fuel stratum (Ottmar et al. 2007). Descriptive variables for all subplots included: region name, site name, treatment, subplot number, sampling year, UTM coordinates at zero corner, percent slope, aspect, macrotopography (ridgetop, sideslope, terrace, or bottom), and microtopography (flat, convex, or concave).

The sagebrush sites were broken into the four descriptive Groups, identified in the pre-treatment Guide, that make up the post-treatment Sagebrush Steppe sub-guide. All subplots from the seven sites were categorized by less than or greater than 25% pre-treatment sagebrush cover and less than or greater than 25% total pre-treatment grass cover. This allows the user to more efficiently assign their field site to a group based on an ocular pre-treatment cover estimate. These groups were maintained for the post-treatment Guide to allow comparison with the pre-treatment Guide (Stebleton and Bunting 2009).

The post-treatment woodland subplots also maintained their pre-treatment designation by phases. The phases were classified by the method proposed by Miller et al. (2005): Phase 1, trees may be present on the site but the shrub and herbaceous layers are the dominant influence on ecological processes (hydrologic, nutrient, and energy cycles); Phase 2, trees are co-dominant with the shrub and herbaceous layers; and Phase 3, trees are the dominant vegetation as well as the primary layer influencing ecological processes. Three different sub-guides, Pinyon-Juniper Fuels Guide, Utah Juniper Fuels Guide, and Western Juniper Fuels Guide, were developed to capture the diversity between the different woodlands (Stebleton and Bunting 2009). Again these phases were maintained for comparison purposes in the post-treatment Guide.

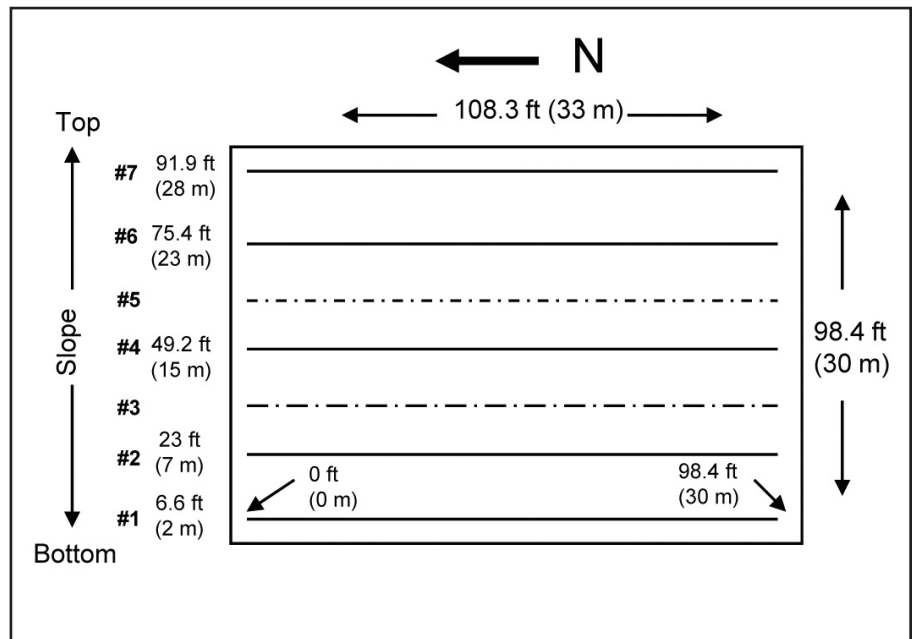


Figure 2. Subplot and transect layout. Solid lines signify vegetation transects; dotted lines denote fuels transects.

Table 1. Sampling methods used for each of the reported variables by fuel stratum (Ottmar et al. 2007). Refer to Figure 2 for transect number reference.

| Stratum | Variable(s) | Method | Transect(s)# |
|---|---|---|-----------------------------------|
| Trees | Cover | Census data and line point intercept (Bonham 1989) | 1, 2, 4, 6, 7 |
| | Density <1.6 ft (0.5 m) tall | Belt transect (Krebs 1999; Salzer 1994) | 2, 4, 6 |
| Shrubs | Cover | Line point intercept (Bonham 1989) | 1, 2, 4, 6, 7 |
| | Height | Nested circular frame (Bonham 1989) | 4 |
| | Density | Belt transect (Krebs 1989; Salzer 1994) | 2, 4, 6 |
| | | Nested circular frame (Bonham 1989) | 4 |
| | Loading and bulk density | Harvest (Pechanec and Pickford 1937; Riser 1984) | NA |
| Nested circular frame (Bonham 1989) | | 4 | |
| Nonwoody Fuels | Cover | Line point intercept (Bonham 1989) | 1, 2, 4, 6, 7 |
| | Height | 19.7 in. x 19.7 in. (50 cm x 50 cm) quadrat (Bonham 1989) | 3 in 2008 and 2010 ; 5 in 2009 |
| | Loading and bulk density | Harvest (Pechanec and Pickford 1937; Riser 1984) | 3 in 2008 and 2010 ; 5 in 2009 |
| | | 19.7 in. x 19.7 in. (50 cm x 50 cm) quadrat (Bonham 1989) | 3 in 2008 and 2010 ; 5 in 2009 |
| Woody Fuels | 10-hour loading | Planar intercept (Brown et al. 1982) | 2, 4, 6 |
| | 100-hour loading | Planar intercept (Brown et al. 1982) | 2, 4, 6 |
| | 1000-hour sound and rotten loading | Planar intercept (Brown et al. 1982) | 1, 2, 4, 6, 7 |
| Litter and Duff | Cover | Line point intercept (Bonham 1989) | 1, 2, 4, 6, 7 |
| | Interspace loading and bulk density | Harvest (Pechanec and Pickford 1937; Riser 1984) | 3 in 2008 and 2010; 5 in 2009 |
| | | 9.8 in. x 9.8 in. (25 cm x 25 cm) quadrat (Bonham 1989) | 3 in 2008 and 2010 ; 5 in 2009 |
| | Tree litter and duff depth, loading, and bulk density | Harvest (Pechanec and Pickford 1937; Riser 1984) | NA |
| 9.8 in. x 9.8 in. (25 cm x 25 cm) quadrat (Bonham 1989) | | NA | |

Four treatments were implemented across the sagebrush sites: untreated control, fire, mechanical (mow), and herbicide (Mclver et al. 2010). The objective for all treatments, except for the control, was to reduce sagebrush dominance. All fire treatments were conducted in the fall and implemented by agency personnel. The objective of the burn treatment was to blacken 100% of the area with a low-severity prescribed burn, however, at most sites, only 20–95% of the area was burned. The mechanical treatment involved mowing the sagebrush to a height of approximately 12 in. (30.5 cm) (Olsen 2009). The objectives were to open the sagebrush canopy and reduce sagebrush abundance by 50%. The herbicide treatment required the application of the herbicide Tebuthiuron (Spike 20P™) applied aerially in the form of pellets at a rate of 1–1.5 lbs/acre (1.1–1.7 kg/ha) (Olsen 2009). Again the objective was to reduce sagebrush abundance by 50%.

The woodland sites employed three treatments: untreated control, fire, and mechanical cutting (Mclver et al. 2010). The fire treatments were conducted in the fall by agency personnel. Although the objective was to burn 100% of the study site with a low-severity prescribed burn (Mclver et al. 2010), results varied depending on fuel characteristics and weather conditions (Olsen 2009). To meet research objectives, field crews returned to the subplots for follow-up burning of individual trees (Olsen 2009). The mechanical treatment involved using a chainsaw to clear-cut all trees greater than 1.6 ft (0.5 m) tall (Mclver et al. 2010). Trees were left where they fell. Due to local interest, the Utah Juniper sites employed a fourth treatment, mechanical shredding using a Bull Hog™ (Olsen 2009). All trees greater than 1.6 ft (0.5 m) tall were masticated and all fuel was left on the site (Olsen 2009).

All reported measurements were converted to English units to allow for quick input into computer fire behavior and fire effects models as well as to account for manager preference. A conversion table is provided in Appendix II. Minimum, maximum and mean values are reported to allow the user to better assess their site within the range represented by a particular group or phase. Only common species are reported in this Guide. All species codes, common names and scientific names are in agreement with the USDA Plants Database (USDA NRCS 2011) and are reported in Appendix I.

Trees

Total tree canopy cover for each subplot was derived from 300 intercept points per subplot (60 points across 5 transects) using the line point intercept method (Bonham 1989). Any live branches (denoted by green foliage) of trees rooted within the subplot were counted. Trees less than 1.6 ft (0.5 m) tall were counted within a 3.3-ft (1-m) belt on either side of 3 transects giving sapling density (Table 1).

Shrubs

Total shrub canopy cover for each subplot was derived from 300 intercept points per subplot (60 points over 5 transects) using the line point intercept method (Bonham 1989; Table 1). For common shrub species, densities were derived from counts within a 3.3-ft (1-m) belt on either side of 3 transects (Table 1). The most abundant shrub species separated by height class, 2–6 in. (5–15 cm) tall or greater than 6 in. (15 cm) tall, were tallied; rare shrubs that landed within the belt were recorded but not separated by height class. Dead shrubs were tallied but not separated by species. All shrub species taller than 6 in. (15 cm) were measured at 5 sample points along transect 4 (Table 1). Height, longest diameter and perpendicular diameter were recorded within either 3.3-, 6.6-, or 9.8-ft (1-, 2-, or 3-m) radius nested circular frames.

Size of the nested plot was chosen based on the minimum requirement to measure at least 15 of each common shrub species per subplot. Shrubs must have been rooted within the nested plot to be counted. Shrubs with less than 10% live canopy cover were not recorded. A range of sizes of dominant shrub species, as identified by the site managers, were destructively sampled and separated into the different fuel classes (1-hour [includes foliage], 10-hour and 100-hour) (Stebleton and Bunting 2009). Samples were oven-dried at 58°F for 48 hours. Total shrub loading was calculated as the difference between the wet field weight and dry weight (Pechanec and Pickford 1937). Site- and species-specific regressions were developed from the destructively sampled shrubs to predict shrub loadings using height, longest diameter, perpendicular diameter and volume as covariates (Rittenhouse and Senva 1977, Stebleton and Bunting 2009). Reported R^2 values in Appendix V are the lowest R^2 obtained across the different size classes. Standing dead shrub loading was not directly measured, but was calculated by subtracting the post-treatment live loading by size class from the pre-treatment live loading by size class. Standing dead shrub loading is only reported for the sagebrush sites, in Appendix IV, because the woodland sites did not employ a herbicide treatment. Available loading, used to calculate shrub bulk density, assumed all foliage, standing dead and 1-hour fuels consumed while only 50% of the 10-hour live fuels consumed*. Shrub live and dead loadings by size class and available loadings are reported in Appendix IV.

Nonwoody Fuels

Total perennial and annual grass and forb canopy cover for each subplot were derived from 300 intercept points per subplot (60 points over 5 transects) using the line point intercept method (Bonham 1989; Table 1). Total loadings were derived through destructive sampling along the fuels transect. All herbaceous vegetation, standing litter, and surface litter were collected from a 19.7 x 19.7 in. (50 x 50 cm) quadrat (Bonham 1989) with 15 sample points in the woodland sites and 8 sample points in the sagebrush sites. Heights of the tallest grass and forb were measured before clipping. All vegetation was removed within 2.5 in. (1 cm) of the ground and sorted as live herbaceous, standing dead herbaceous and litter. Sub-samples were oven-dried at 58°F for 48 hours. Total herbaceous loading was calculated by multiplying the percentage of dried biomass of the sub-sample by the total sample's wet weight (Pechanec and Pickford 1937). Bulk density was calculated using the total loading, assuming the available fuel is 100%, and taking the landscape average of all grass and forb heights.

*Wright, C.S. 2008. Personal Communication. Research Forester, USDA Forest Service, Pacific Northwest Research Station, Pacific Wildland Fire Sciences Laboratory, Seattle, WA.

Woody Fuels

A modification of the planar intercept method (Brown et al. 1982) was used to sample down woody debris within subplots. Ten- and 100-hour fuels were tallied below 6.6 ft (2 m) along 3 transects (297 ft (90 m) total) per subplot (Table 1). A diameter for each 1000-hour fuel was measured at the point of intersection along 5 transects, 492.1 ft (150 m), per subplot and a decay class of sound or rotten was assigned to each (Brown, 1974; Table 1). Shredded fuels, in the Utah Juniper region, were categorized by size class and reported as woody fuel. One-hour fuels were not tallied. Brown's (1974) equations were used to assign loadings, by size class, for each subplot.

Litter and Duff

Interspace litter was collected from 19.7 x 19.7 in. (50 x 50 cm) quadrats (Bonham 1989) sampled at 15 sample points in the woodland sites and at 8 sample points in the sagebrush sites. Litter was collected following the clipping of all herbaceous vegetation within the 19.7 x 19.7 in. (50 x 50 cm) quadrat (Bonham 1989). Sub-samples were oven-dried at 58°F for 48 hours. Total interspace litter loading was calculated by multiplying the percentage of dried biomass of the sub-sample by the total sample's wet weight (Pechanec and Pickford 1937).

Tree litter and duff samples were collected from 6 trees, used in pre-treatment sampling, greater than 6.6 ft (2 m) in crown diameter rooted within the subplot; 2 closest to the center and 1 closest to each of the 4 corners. A 9.8 x 9.8 in. (25 x 25 cm) quadrat (Bonham 1989) was used to sample at the base of the tree, 1/3 of the canopy from the base for trees 6.6–13.1 ft (2–4 m) in crown diameter, and 2/3 of the canopy from the base for trees greater than 13.1 ft (4 m) in crown diameter. The litter and duff was separated and weighed in the field. Sub-samples were oven-dried at 58°F for 48 hours. Total loading was calculated by multiplying the percentage of dried biomass of the sub-sample by the total sample's wet weight (Pechanec and Pickford 1937). Litter and duff depths were measured from the remaining profile within the quadrat once all material was removed. The difference in the wet and dry weights combined with the depths were used to calculate the litter and duff bulk density assuming all fuel was available.

Bare ground percent cover was derived from hits along 300 intercept points per subplot (60 points over 5 transects) using the line point intercept method (Bonham 1989; Table 1). This is the only measure of fuel continuity.

Fuel Trends 2 Years Post-treatment

After compiling the data, a few trends were noted. No statistical analyses were performed on the data, these are strictly observations. Overall, fuel loading typically increased across all of the controls from pre- to post-treatment.

When the fire treatment met the objective of blackening 100% of the plot with a low-severity prescribed burn, it was very effective at reducing fuel loading. However, when this objective was not met it was not an effective treatment for fuel reduction. This can be seen in the data where there is little change in the fuel loading post-treatment. In areas where cheatgrass was present before the prescribed burn, it became a large component of the surface fuel complex post-burn.

The mechanical treatment in the sagebrush sites did not appear to affect the overall surface fuel loading. This could have been due to the height at which the shrubs were mowed or because the mowing actually stimulated growth. In the woodland sites, the mechanical treatments (removal of all trees within a subplot by either cutting or mechanical shredding) redistributed the fuels moving them from a canopy fuel to a down, dead woody surface fuel. Also, as noted by the site managers, if the whole juniper was not completely removed from the stump or the stump was not cut low enough to the ground (leaving living branches), cutting and mastication did not kill the juniper.

Finally, the herbicide treatment had varying effectiveness on the sagebrush sites. There were very few subplots where Tebuthiuron (Spike 20P™) resulted in significant top-kill. This could have been a result of poor distribution of herbicide or not enough herbicide to affect healthy shrubs.

Using the Post-treatment Fuels Guide

The *Guide for Quantifying Post-treatment Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin* will help users quickly and inexpensively estimate fuel loadings on treated sites. When used in conjunction with the pre-treatment Guide (Stebbleton and Bunting 2009), the post-treatment Guide has the capability to predict vegetation and fuel response to the various treatment applications, assess target conditions, set realistic management objectives for restoration projects, and determine treatment effectiveness. Designed similarly to the Natural Fuels Photo Series, produced by the USDA Forest Service Fire and Environmental Research Applications team (FERA), this Guide provides the necessary landscape-level inputs required by existing fire behavior models. Through the use of photographs and tables, with the range of values, users can quickly appraise fuels by the various fuel strata or use it to predict possible treatment outcomes. Because of the high variability of fuel distribution across individual sites, it is generally necessary to use more than one site from the post-treatment Guide to represent each particular fuel strata of a field site.

The post-treatment Guide is divided into four sub-guides (one sagebrush and three woodland guides) based on regional differences in site physiognomy and ecology: Sagebrush Steppe, Pinyon-Juniper, Utah Juniper, and Western Juniper. Sections are aggregated into groups by total pre-treatment sagebrush cover and total grass cover in the Sagebrush Steppe Guide and by pre-treatment phases (Miller et al. 2005) in the Woodland Guides (refer to Methods section for further explanation). Groups and phases are further subdivided by treatment: control, fire, mechanical (cutting, shredding and mowing), and herbicide. Two photos depict the range of canopy cover by life-form within the group or phase. Photos are arranged by increasing cover of the dominant overstory vegetation. The user notes and information at the top of photo pages give more background on specific sites sampled. Refer to Figure 1 for site names and locations. Number of subplots reported is the number of sampling units for that particular group or phase. Elevation for each photo is the elevation for that specific subplot. Elevation ranges for data are listed under general site information.

Six steps for effective use:

1. Determine your objective for using the post-treatment Guide. Most often it will be most effectively used in conjunction with the pre-treatment *Guide for Quantifying Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin* (Stebbleton and Bunting 2009).
2. Assess each fuel stratum individually (trees, shrubs, nonwoody fuel, woody fuel, and litter).
3. Compare the field site to the Guide group(s) or phase(s) that most closely resembles field observations. Multiple groups or phases may need to be used to capture the variability of the field site.
4. Decide where within the range of values the fuel strata of the field site fits and/or interpolate between groups or phases.
5. Some strata are not possible to estimate using photos (litter and duff depths). A combination of field sampling and observations with this Guide should be incorporated for the most accurate results.
6. Repeat these steps for each fuel stratum of interest to obtain the necessary inputs.

Author Recommendations for Guide Use

For the user to most effectively use this Guide, we recommend accounting for the assumptions and limitations listed below.

- Sampling on all sites took place from April to August (See Guide Notes in the sub-guides for more specifics). No distinction for seasonality was made in the reported variables. When comparing field sites to the photographs and reported values, be sure to account for the difference in seasonality. This is especially critical regarding the loadings of live and dead herbaceous fuels.
- Minimum and maximum values are included to capture the range of variability within groups or phases. However, in most cases, data are not normally distributed and reported means are much closer to minimum than maximum values.
- It is difficult to distinguish woody fuels, litter, and duff fuel strata in the photographs. Independent sampling or observations may be required to gain the most accurate values for these strata.
- One-hour fuels were not collected. If this information is required, the user should make this measurement.
- Shredded fuels were assigned to a size class, and loadings were calculated using Browns (1974). This method violates Brown's (1974) assumption of circular fuels, however, this was the best available method during data collection.
- Fuel bed depth, a critical input in existing fire behavior models, was not measured. It is NOT recommended to assume this value using the heights reported in the Guide. This should be measured on the site due to the sensitivity of the Rothermel surface fire spread model (Rothermel 1972) to this input.
- Treatments were implemented under the best available conditions to achieve objectives identified. Make necessary adjustments when different objectives are identified. Also, results may vary considerably when outside factors, such as weather or resource availability, significantly influence the treatment application.
- The organization and layout of this Guide is based on pre-treatment established conditions. Using this Guide in conjunction with the pre-treatment *Guide for Quantifying Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin* (Stebleton and Bunting 2009) is highly recommended.

Further Information

- Joint Fire Science Program (JFSP): <http://www.firescience.gov>
- Sagebrush Steppe Treatment Evaluation Project (SageSTEP): <http://www.sagestep.org>
- *Guide for Quantifying Fuels in the Sagebrush Steppe and Juniper Woodlands of the Great Basin*: <http://www.cnr.uidaho.edu/GBFuelsGuide> or <http://www.sagestep.org/pdfs/SageSTEPFuelsGuide.pdf>
- University of Idaho, Department of Rangeland Ecology and Management: <http://www.cnr.uidaho.edu/range>
- USDA Forest Service Fire and Environmental Research Applications team (FERA): <http://www.fs.fed.us/pnw/fera/>
- Natural Fuels Photo Series (Digital): <http://depts.washington.edu/nwfire/dps/>

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Sagebrush Steppe Fuels Guide: 4 Groups, 4 Treatments

User Notes

Site Notes

- Four groups with four treatments represent the SageSTEP Sagebrush/Cheatgrass East and West sites characterized by the Loamy 10–12” ecological type (NRCS 1997).
- General site information:
 - Average annual precipitation ranges between 8.5–12.8 in. (21.6–32.5 cm) averaging 11 in. (27.9 cm);
 - Slopes (0–10%), all aspects;
 - ‘Loamy’ soil texture, and soil depths >20 in. (50.8 cm) with minimal stoniness.
- Prior to cheatgrass invasion, typical fire return interval on these sites was from several decades to 100 years (Wright and Bailey 1982). Since the introduction of cheatgrass the fires have been larger, often with a return interval of less than 10 years (Whisenant 1990).
- Four treatments were employed across the region: control, fire, mechanical (mow), and herbicide.
- Rock Creek and Gray Butte are the only sites that are not within active grazing allotments. All other subplots may have been grazed prior to construction of the exclosures at the beginning of the SageSTEP project.
- Site locations and elevation range for data used in tables are as follows:
 - Group 1: **Control:** Roberts, Rock Creek, Gray Butte; 18 subplots; 4865–4961 ft (1483–1512 m)
Fire: Roberts, Rock Creek, Gray Butte; 10 subplots; 4823–4954 ft (1470–1510 m)
Mow: Roberts, Rock Creek, Gray Butte; 12 subplots; 4856–4951 ft (1480–1509 m)
Herbicide: Gray Butte, Onaqui, Owyhee, Roberts; 18 subplots; 4852–5531 ft (1479–1686 m)
 - Group 2: **Control:** Gray Butte, Moses Coulee, Owyhee, Roberts, Rock Creek, Saddle Mt; 24 subplots; 906–5341 ft (276–1628 m)
Fire: Onaqui, Roberts, Rock Creek, Saddle Mt; 21 subplots; 846–5449 ft (258–1676 m)
Mow: Gray Butte, Moses Coulee, Onaqui, Owyhee, Roberts, Rock Creek, Saddle Mt; 34 subplots; 899–5505 ft (274–1637 m)
Herbicide: Gray Butte, Moses Coulee, Onaqui, Owyhee, Rock Creek; 28 subplots; 899–5505 ft (524–1686 m)
 - Group 3: **Control:** Gray Butte, Owyhee, Roberts; 9 subplots; 4925–5341 ft (1501–1628 m)
Fire: Gray Butte, Owyhee, Rock Creek; 18 subplots; 4902–5377 ft (1494–1639 m)
Mow: Onaqui, Owyhee; 8 subplots; 5371–5505 ft (1637–1678 m)
Herbicide: Gray Butte, Owyhee; 9 subplots; 4905–5318 ft (1495–1621 m)
 - Group 4: **Control:** Moses Coulee, Onaqui, Saddle Mt; 18 subplots; 4902–5377 ft (276–1671 m)
Fire: Onaqui, Owyhee, Roberts, Rock Creek, Saddle Mt; 23 subplots; 846–5499 ft (258–1676 m)
Mow: Gray Butte, Onaqui, Owyhee, Roberts, Saddle Mt; 18 subplots; 899–5505 ft (274–1678 m)
Herbicide: Onaqui, Owyhee, Saddle Mt; 17 subplots; 879–5531 ft (268–1686 m)

Guide Notes

1. Groups are organized by **pre-treatment** total shrub and total grass cover, perennial and annual grass combined (Stebleton and Bunting 2009).
 - Group 1: Shrub cover = 0–25%; Total grass cover = 0–25%
 - Group 2: Shrub cover = 0–25%; Total grass cover = >25%
 - Group 3: Shrub cover = >25%; Total grass cover = 0–25%
 - Group 4: Shrub cover = >25%; Total grass cover = >25%
2. Treatments, abbreviations and treatment objectives:
 - Control (CO): Untreated
 - Fire (FI): Objective was to blacken 100% of the plot area with a low-severity prescribed burn (not all plots met objective).
 - Mow (MO): Sagebrush was mowed to a height of ~12-15 in. (30.5–38.1 cm) throughout the plot.
 - Herbicide (TE): Tebuthiuron (Spike 20P™) pellets were applied aerially at a rate of ~1.5 lbs/acre (1.7 kg/ha) with an objective of at least 50% sagebrush mortality (not all plots met mortality objective).
3. The caption above the photos denotes measured percent live cover by fuel stratum for that post-treatment photo. This may or may not match up with the Group it was assigned to since Group placement was based on pre-treatment conditions.
4. Sampling took place between April and August in 2008, 2009, and 2010. The date of the photo is in the lower right hand corner.
5. Percent bare ground is the only reported measure of fuel continuity.
6. Dominant graminoids: ACHY, ACTH7, BRTE, ELEL5, HECO26, LECI4, PASM, POCU3, POSE, and PSSPS
7. BRTE is the only annual grass reported with the exception of a small amount of BRAR5 found in Group 2.
8. Shrub loadings are restricted by height, longest diameter, perpendicular diameter and volume. Refer to Appendix V, 'Sagebrush Steppe', for sample ranges used in this study and R² values.
9. Minimum values presented with an asterisk (*) indicate minimum value when present. Mean value includes all subplots.
10. The designation of "NA" indicates data were not available.
11. Tables of species codes and metric conversions can be found in Appendix I and II.

Sagebrush Steppe: Group 1, Control

(Pre-treatment Cover: Shrub: 0–25%; Total grass: 0–25%)

Site: Hart Mountain-Rock Creek **Elevation:** 4961 ft (1512 m)
Shrubs: 17% Perennial Grass: 19% Total Grass: 20% Bare Ground: 33%



07/25/09

Site: Roberts **Elevation:** 4865 ft (1483 m)
Shrubs: 30% Perennial Grass: 13% Total Grass: 48% Bare Ground: 18%



07/20/09

Sagebrush Steppe: Group 1, Fire

(Pre-treatment Cover: Shrub: 0–25%; Total grass: 0–25%)

Site: Hart Mountain-Gray Butte **Elevation:** 4902 ft (1494 m) **Treatment Date:** 10/2008

Shrubs: 1% Perennial Grass: 13% Total Grass: 42% Bare Ground: 32%



07/21/10

Site: Roberts **Elevation:** 4823 ft (1470 m) **Treatment Date:** 09/2007
Shrubs: 9% Perennial Grass: 23% Total Grass: 55% Bare Ground: 2%



07/07/09

Sagebrush Steppe: Group 1, Mow

(Pre-treatment Cover: Shrub: 0–25%; Total grass: 0–25%)

Site: Roberts **Elevation:** 4856 ft (1480 m) **Treatment Date:** 10/2007
Shrubs: 3% Perennial Grass: 8% Total Grass: 93% Bare Ground: 7%



07/09/09

Site: Hart Mountain-Rock Creek **Elevation:** 4856 ft (1480 m) **Treatment Date:** 09/2007
Shrubs: 9% Perennial Grass: 25% Total Grass: 30% Bare Ground: 25%



07/09/09

Sagebrush Steppe: Group 1, Herbicide

(Pre-treatment Cover: Shrub: 0–25%; Total grass: 0–25%)

Site: Hart Mountain-Gray Butte **Elevation:** 4905 ft (1495 m) **Treatment Date:** 11/2008

Shrubs: 8% Perennial Grass: 15% Total Grass: 19% Bare Ground: 19%



07/13/10

Site: Roberts **Elevation:** 4852 ft (1479 m) **Treatment Date:** 10/2007

Shrubs: 17% Perennial Grass: 12% Total Grass: 40% Bare Ground: 32%



07/15/09

Sagebrush Steppe: Group 1

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total live loading (ton/ac) | | | Standing dead loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|-------|-----------------------------|------|------|--------------------------------|------|-------|-------------------------------------|--------|---------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARTRW8 | CO | 9* | 30 | 18 | 3 | 54 | 16 | 1,681 | 7,767 | 4,706 | 0.72 | 4.22 | 1.91 | NA | | | 0.0001 | 0.0521 | 0.0113 |
| | FI | <1* | 27 | 11 | 4 | 33 | 12 | 23* | 7,426 | 2,630 | 0.05* | 3.79 | 1.19 | | | | 0.0001* | 0.0023 | 0.0008 |
| | MO | 2* | 17 | 9 | <1 | 28 | 16 | 1,272 | 6,972 | 2,930 | 0.11* | 1.33 | 0.50 | | | | <0.0001* | 0.0252 | 0.0088 |
| | TE | 2 | 27 | 15 | 3 | 50 | 18 | 1,090 | 6,427 | 3,161 | 0.44* | 6.19 | 2.05 | 0.15* | 4.31 | 0.84 | 0.0001* | 0.1321 | 0.0241 |
| CHVI8 | CO | <1* | 9 | 2 | 3 | 18 | 10 | 91 | 636 | 52 | <0.01* | 1.17 | 0.19 | NA | | | <0.0001* | 0.0039 | 0.0003 |
| | FI | <1* | 3 | 1 | 4 | 15 | 10 | 45* | 1,045 | 261 | 0.04* | 0.09 | 0.01 | | | | <0.0001* | 0.0038 | 0.0004 |
| | MO | <1 | 5 | 1 | 5 | 32 | 11 | 56* | 159 | 15 | 0.01* | 0.36 | 0.03 | | | | <0.0001* | 0.0002 | <0.0001 |
| | TE | <1 | 7 | 1 | 1 | 23 | 10 | 23* | 23 | 1 | 0.02* | 1.79 | 0.16 | <0.01* | 0.03 | <0.01 | <0.0001* | 0.0010 | 0.0001 |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Loading (ton/ac) | | |
|-------------------|-----------|-----------------|-----|------|------------------|------|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Interspace litter | CO | 4* | 17 | 9 | 0.02* | 0.37 | 0.09 |
| | FI | 2* | 9 | 3 | 0.02* | 0.08 | 0.04 |
| | MO | 1 | 24 | 10 | 0.02 | 1.41 | 0.34 |
| | TE | 5 | 18 | 10 | <0.01 | 0.59 | 0.06 |
| Bare ground | CO | 4 | 39 | 18 | NA | | |
| | FI | 2 | 42 | 27 | | | |
| | MO | 2 | 42 | 16 | | | |
| | TE | 18 | 57 | 29 | | | |

NONWOODY FUELS

| | CO | | | FI | | | MO | | | TE | | |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 4 | 27 | 14 | 3 | 32 | 16 | 3 | 32 | 17 | 5 | 30 | 16 |
| Total cover: Annual grass [†] (%) | <1 | 77 | 23 | 7 | 69 | 32 | <1* | 84 | 33 | <1* | 34 | 16 |
| Total cover: Forbs (%) | 4 | 79 | 29 | 11 | 90 | 34 | 6 | 91 | 31 | 2 | 48 | 22 |
| Grass height (in.) | 5 | 12 | 9 | 6 | 17 | 10 | 4 | 15 | 10 | 4 | 14 | 9 |
| Forb height (in.) | 2* | 11 | 3 | 5* | 15 | 5 | 4* | 9 | 4 | 1* | 11 | 2 |
| Live loading (lbs/ac) | 44.77 | 393.95 | 129.08 | 17.91 | 174.59 | 86.85 | 17.91 | 398.43 | 135.79 | 4.48* | 214.88 | 83.84 |
| Dead loading (lbs/ac) | 31.34* | 94.01 | 39.30 | 31.34 | 35.81 | 16.12 | 8.95* | 80.58 | 31.34 | 31.34* | 174.59 | 29.51 |
| Total loading (lbs/ac) | 76.11 | 487.96 | 168.38 | 49.25 | 210.40 | 102.97 | 26.86 | 479.01 | 167.13 | 35.82 | 389.47 | 113.35 |
| Bulk density (lbs/ft ³) | 0.0055 | 0.0238 | 0.0142 | 0.0034 | 0.0689 | 0.0170 | 0.0044 | 0.0305 | 0.016 | 0.0032 | 0.0225 | 0.0133 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | | | | |
|-----------------------------|------------------|------|------|-------|------|------|------|------|-------|-------|------|------|
| | CO | | | FI | | | MO | | | TE | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.08 | 0.79 | 0.25 | 0.03 | 0.51 | 0.20 | 0.14 | 1.21 | 0.43 | 0.18 | 0.77 | 0.30 |
| 1.1–3.0 (100-hour) | 0.10* | 1.08 | 0.40 | 0.05* | 0.84 | 0.20 | 0.15 | 1.53 | 0.59 | 0.05* | 1.13 | 0.40 |
| 3.1–9.0 (1000-hour: Sound) | 0.18* | 1.12 | 0.08 | 0 | | | 0.09 | 0.09 | 0.01 | 0.09* | 0.48 | 0.14 |
| 3.1–9.0 (1000-hour: Rotten) | 0 | | | | | | 0 | 0 | 0.19* | 0.43 | 0.05 | |
| Total loading | 0.36 | 2.99 | 0.73 | 0.08 | 1.35 | 0.40 | 0.38 | 2.83 | 1.03 | 0.51 | 2.81 | 0.89 |

Sagebrush Steppe: Group 2, Control

(Pre-treatment Cover: Shrub: 0–25%; Total grass: >25%)

Site: Hart Mountain-Rock Creek **Elevation:** 4961 ft (1512 m)

Shrubs: 17% Perennial Grass: 19% Total Grass: 19% Bare Ground: 46%



Site: Saddle Mountain **Elevation:** 906 ft (276 m)

Shrubs: 25% Perennial Grass: 28% Total Grass: 46% Bare Ground: 9%



Sagebrush Steppe: Group 2, Fire

(Pre-treatment Cover: Shrub: 0–25%; Total grass: >25%)

Site: Saddle Mountain **Elevation:** 846 ft (258 m) **Treatment Date:** 09/2008

Shrubs: 0% Perennial Grass: 45% Total Grass: 50% Bare Ground: 25%



Site: Onaqui **Elevation:** 5499 ft (1676 m) **Treatment Date:** 09/2006

Shrubs: 2% Perennial Grass: 21% Total Grass: 21% Bare Ground: 48%



Sagebrush Steppe: Group 2, Mow

(Pre-treatment Cover: Shrub: 0–25%; Total grass: >25%)

Site: Moses Coulee **Elevation:** 1719 ft (524 m) **Treatment Date:** 02/2009
Shrubs: 9% Perennial Grass: 43% Total Grass: 55% Bare Ground: 16%



Site: Hart Mountain-Gray Butte **Elevation:** 4915 ft (1498 m) **Treatment Date:** 10/2008
Shrubs: 13% Perennial Grass: 8% Total Grass: 39% Bare Ground: 12%



Sagebrush Steppe: Group 2, Herbicide

(Pre-treatment Cover: Shrub: 0–25%; Total grass: >25%)

Site: Moses Coulee **Elevation:** 1719 ft (524 m) **Treatment Date:** 11/2008

Shrubs: 16% Perennial Grass: 30% Total Grass: 53% Bare Ground: 45%



05/17/10

Site: Onaqui **Elevation:** 5531 ft (1686 m) **Treatment Date:** 10/2006

Shrubs: 22% Perennial Grass: 23% Total Grass: 23% Bare Ground: 24%



06/12/08

Sagebrush Steppe: Group 2

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total live loading (ton/ac) | | | Standing dead loading (ton/ac) | | | Bulk density (lbs/ft³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|-------|-----------------------------|------|-------|--------------------------------|------|------|------------------------|---------|---------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARTRW8 | CO | 1 | 25 | 14 | 4 | 72 | 24 | 817 | 6,722 | 2,343 | 0.12 | 4.45 | 1.65 | NA | | | 0.0100 | 0.0997 | 0.0237 |
| | FI | <1* | 27 | 7 | 3 | 57 | 20 | 45* | 3,792 | 1,198 | 0.01* | 3.46 | 0.60 | | | | 0.0001* | 0.0056 | 0.0005 |
| | MO | <1* | 24 | 7 | 5 | 46 | 15 | 23 | 4,519 | 1,763 | 0.03* | 2.93 | 0.60 | | | | 0.0014* | 0.0833 | 0.0122 |
| | TE | 2* | 20 | 11 | 6 | 59 | 25 | 568 | 3,179 | 1,674 | 0.42 | 5.60 | 1.69 | 0.01* | 1.58 | 0.23 | <0.0001* | 0.0574 | 0.0175 |
| CHVI8 | CO | <1 | 3 | <1 | 6 | 20 | 10 | 23* | 658 | 59 | <0.01* | 0.01 | <0.01 | NA | | | <0.0001* | <0.0001 | <0.0001 |
| | FI | <1 | 1 | <1 | 6 | 13 | 9 | 0 | | | <0.01* | 0.03 | <0.01 | | | | <0.0001* | <0.0001 | <0.0001 |
| | MO | <1* | 3 | <1 | 3 | 20 | 11 | 23* | 1,499 | 102 | 0.01* | 0.10 | 0.01 | | | | 0.0030* | 0.0052 | 0.0004 |
| | TE | <1 | 2 | <1 | 7 | 18 | 11 | 23* | 341 | 24 | NA | | | | | | NA | | |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Loading (ton/ac) | | |
|-------------------|-----------|-----------------|-----|------|------------------|------|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Interspace litter | CO | 3* | 36 | 13 | <0.01* | 0.46 | 0.11 |
| | FI | <1* | 12 | 5 | <0.01* | 0.13 | 0.04 |
| | MO | 2* | 44 | 15 | <0.01* | 1.48 | 0.29 |
| | TE | 4 | 22 | 14 | 0.02 | 0.78 | 0.16 |
| Bare ground | CO | 3 | 53 | 32 | NA | | |
| | FI | 10 | 49 | 25 | | | |
| | MO | 3* | 40 | 22 | | | |
| | TE | 11 | 49 | 29 | | | |

NONWOODY FUELS

| | CO | | | FI | | | MO | | | TE | | |
|--------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass† (%) | 7 | 50 | 25 | 7 | 45 | 22 | 3 | 72 | 29 | 3 | 44 | 25 |
| Total cover: Annual grass† (%) | 1* | 77 | 14 | 1* | 73 | 28 | <1* | 82 | 27 | <1* | 47 | 13 |
| Total cover: Forbs (%) | <1* | 21 | 7 | 3 | 67 | 33 | 1 | 99 | 14 | 1* | 20 | 6 |
| Grass height (in.) | 4 | 15 | 8 | 4 | 13 | 9 | 4 | 15 | 9 | 4 | 13 | 8 |
| Forb height (in.) | 1* | 18 | 4 | 3* | 13 | 3 | 1* | 17 | 4 | 1* | 9 | 3 |
| Live loading (lbs/ac) | 4.48 | 546.16 | 130.38 | 89.53 | 886.39 | 271.59 | 13.43 | 420.81 | 161.03 | 22.38 | 1,074.41 | 219.01 |
| Dead loading (lbs/ac) | 4.48* | 290.99 | 100.91 | 13.43* | 80.58 | 29.84 | 8.95* | 313.37 | 64.70 | 26.86* | 492.44 | 144.98 |
| Total loading (lbs/ac) | 8.96 | 837.15 | 231.29 | 102.96 | 966.97 | 301.43 | 22.38 | 734.18 | 225.73 | 49.24 | 1,566.85 | 363.99 |
| Bulk density (lbs/ft³) | 0.0039 | 0.1006 | 0.0249 | 0.0124 | 0.0376 | 0.0227 | 0.0019 | 0.0787 | 0.0242 | 0.0077 | 0.1583 | 0.0376 |

†Species used to calculate perennial grass cover were all native, and annual grass cover includes cheatgrass and a small amount of field brome.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | | | | |
|-----------------------------|------------------|------|------|-------|------|------|-------|------|------|-------|------|------|
| | CO | | | FI | | | MO | | | TE | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.09 | 0.98 | 0.31 | 0.06 | 0.69 | 0.17 | 0.04 | 1.10 | 0.42 | 0.11 | 0.95 | 0.32 |
| 1.1–3.0 (100-hour) | 0.10 | 1.23 | 0.49 | 0.05* | 0.30 | 0.11 | 0.05* | 1.62 | 0.72 | 0.10 | 1.18 | 0.49 |
| 3.1–9.0 (1000-hour: Sound) | 0.12* | 0.63 | 0.09 | 0.12* | 0.30 | 0.05 | 0.12* | 0.29 | 0.06 | 0.15* | 0.37 | 0.09 |
| 3.1–9.0 (1000-hour: Rotten) | 0.11* | 0.11 | 0.01 | 0 | | | 0.11* | 0.34 | 0.03 | 0.11* | 0.13 | 0.01 |
| Total loading | 0.42 | 2.95 | 0.90 | 0.23 | 1.43 | 0.42 | 0.32 | 3.35 | 1.23 | 0.47 | 2.63 | 0.91 |

Sagebrush Steppe: Group 3, Control

(Pre-treatment Cover: Shrub: >25%; Total grass: 0–25%)

Site: Hart Mountain-Gray Butte Elevation: 4925 ft (1501 m)
Shrubs: 16% Perennial Grass: 22% Total Grass: 27% Bare Ground: 21%



Site: Hart Mountain-Gray Butte Elevation: 4925 ft (1501 m)
Shrubs: 25% Perennial Grass: 12% Total Grass: 12% Bare Ground: 16%



Sagebrush Steppe: Group 3, Fire

(Pre-treatment Cover: Shrub: >25%; Total grass: 0–25%)

Site: Hart Mountain-Gray Butte **Elevation:** 4902 ft (1494 m) **Treatment Date:** 10/2008

Shrubs: 0% Perennial Grass: 4% Total Grass: 27% Bare Ground: 44%



07/22/10

Site: Hart Mountain-Rock Creek **Elevation:** 4954 ft (1510 m) **Treatment Date:** 09/2007

Shrubs: <1% Perennial Grass: 19% Total Grass: 29% Bare Ground: 39%



07/11/09

Sagebrush Steppe: Group 3, Mow

(Pre-treatment Cover: Shrub: >25%; Total grass: 0–25%)

Site: Onaqui **Elevation:** 5505 ft (1678 m) **Treatment Date:** 10/2006
Shrubs: 17% Perennial Grass: 11% Total Grass: 14% Bare Ground: 29%



Site: Onaqui **Elevation:** 5505 ft (1678 m) **Treatment Date:** 10/2006
Shrubs: 19% Perennial Grass: 22% Total Grass: 22% Bare Ground: 23%



Sagebrush Steppe: Group 3, Herbicide

(Pre-treatment Cover: Shrub: >25%; Total grass: 0–25%)

Site: Hart Mountain-Gray Butte Elevation: 4905 ft (1495 m) Treatment Date: 11/2008

Shrubs: 15% Perennial Grass: 22% Total Grass: 23% Bare Ground: 22%



Site: Hart Mountain-Gray Butte Elevation: 4905 ft (1495 m) Treatment Date: 11/2008

Shrubs: 21% Perennial Grass: 8% Total Grass: 10% Bare Ground: 15%



Sagebrush Steppe: Group 3

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total live loading (ton/ac) | | | Standing dead loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|--------|-------|-----------------------------|------|------|--------------------------------|------|------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARTRW8 | CO | 16* | 45 | 34 | 6 | 78 | 18 | 1,771 | 13,898 | 8,153 | 0.88* | 6.67 | 2.15 | NA | | | 0.0244* | 0.3820 | 0.1718 |
| | FI | <1* | 58 | 11 | 6 | 74 | 18 | 23* | 12,627 | 2,304 | 0.01* | 3.80 | 0.62 | | | | 0.0001* | 0.3730 | 0.0602 |
| | MO | 5 | 15 | 10 | 5 | 21 | 11 | 2,316 | 6,359 | 3,822 | 0.45 | 1.31 | 0.93 | | | | 0.0300 | 0.0838 | 0.0537 |
| | TE | 15* | 35 | 25 | 6 | 48 | 21 | 1,794 | 5,859 | 3,919 | 1.97* | 8.75 | 2.35 | 0.36* | 8.37 | 2.09 | 0.0227* | 0.2099 | 0.0945 |
| CHVI8 | CO | 1* | 1 | <1 | 6 | 17 | 12 | 23* | 636 | 81 | 0.07* | 0.07 | 0.01 | NA | | | 0.0033* | 0.0033 | 0.0004 |
| | FI | <1* | 3 | 1 | 4 | 15 | 8 | 23* | 749 | 74 | NA | | | | | | NA | | |
| | MO | <1* | 3 | 1 | 3 | 14 | 8 | 0 | | | | | | | | | | | |
| | TE | 0 | | | 0 | | | 68* | 68 | 10 | | | | | | | | | |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Loading (ton/ac) | | |
|-------------------|-----------|-----------------|-----|------|------------------|------|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Interspace litter | CO | 14 | 22 | 17 | <0.01 | 0.40 | 0.10 |
| | FI | <1* | 17 | 8 | <0.01* | 0.14 | 0.02 |
| | MO | 17 | 36 | 28 | <0.01 | 0.04 | 0.02 |
| | TE | 12 | 21 | 17 | <0.01 | 0.22 | 0.06 |
| Bare ground | CO | 16 | 39 | 29 | NA | | |
| | FI | 15 | 97 | 51 | | | |
| | MO | 13 | 41 | 28 | | | |
| | TE | 15 | 58 | 33 | | | |

NONWOODY FUELS

| | CO | | | FI | | | MO | | | TE | | |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 1 | 22 | 8 | 1 | 23 | 9 | 4 | 22 | 11 | 5 | 22 | 11 |
| Total cover: Annual grass [†] (%) | <1* | 18 | 3 | <1* | 43 | 8 | 1* | 8 | 3 | <1* | 4 | 1 |
| Total cover: Forbs (%) | <1* | 15 | 3 | 1* | 34 | 13 | 1 | 19 | 9 | <1* | 20 | 7 |
| Grass height (in.) | 4* | 12 | 5 | 2* | 19 | 6 | 4 | 7 | 6 | 3* | 11 | 7 |
| Forb height (in.) | 1* | 7 | 2 | 1* | 15 | 5 | 2* | 3 | 2 | 6* | 10 | 4 |
| Live loading (lbs/ac) | 4.48 | 129.82 | 34.82 | 4.48 | 514.82 | 60.19 | 4.48 | 134.30 | 58.84 | 13.43 | 80.58 | 47.96 |
| Dead loading (lbs/ac) | 62.67* | 102.96 | 28.82 | 4.48* | 152.21 | 10.69 | 4.48* | 62.67 | 17.91 | 8.95* | 67.15 | 14.71 |
| Total loading (lbs/ac) | 67.15 | 232.78 | 63.64 | 8.96 | 667.03 | 70.88 | 8.96 | 196.97 | 76.75 | 22.38 | 147.73 | 62.67 |
| Bulk density (lbs/ft ³) | 0.0024 | 0.0285 | 0.0081 | 0.0041 | 0.1610 | 0.0176 | 0.0035 | 0.0202 | 0.0098 | 0.0008 | 0.0191 | 0.0070 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | | | | |
|-----------------------------|------------------|------|------|-------|------|------|-------|------|------|-------|------|------|
| | CO | | | FI | | | MO | | | TE | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.22 | 0.82 | 0.41 | 0.01 | 0.62 | 0.19 | 0.27 | 0.55 | 0.40 | 0.16 | 0.40 | 0.28 |
| 1.1–3.0 (100-hour) | 0.10 | 1.58 | 0.67 | 0.10* | 0.84 | 0.22 | 0.49 | 1.77 | 0.93 | 0.34 | 1.03 | 0.60 |
| 3.1–9.0 (1000-hour: Sound) | 0.15* | 0.15 | 0.02 | 0.09* | 0.88 | 0.11 | 0.12* | 0.36 | 0.13 | 0.12* | 0.49 | 0.12 |
| 3.1–9.0 (1000-hour: Rotten) | 0.11* | 0.11 | 0.01 | 0.09* | 0.49 | 0.08 | 0.16* | 0.50 | 0.20 | 0.07* | 0.22 | 0.04 |
| Total loading | 0.58 | 2.66 | 1.11 | 0.29 | 2.83 | 0.60 | 1.04 | 3.18 | 1.66 | 0.69 | 2.14 | 1.04 |

Sagebrush Steppe: Group 4, Control

(Pre-treatment Cover: Shrub: >25%; Total grass: >25%)

Site: Saddle Mountain Elevation: 906 ft (276 m)

Shrubs: 18% Perennial Grass: 7% Total Grass: 58% Bare Ground: 10%



04/30/10

Site: Moses Coulee Elevation: 1709 ft (521 m)

Shrubs: 22% Perennial Grass: 51% Total Grass: 70% Bare Ground: 48%



05/13/10

Sagebrush Steppe: Group 4, Fire

(Pre-treatment Cover: Shrub: >25%; Total grass: >25%)

Site: Hart Mountain-Rock Creek **Elevation:** 4954 ft (1510 m) **Treatment Date:** 09/2007
Shrubs: 1% Perennial Grass: 13% Total Grass: 47% Bare Ground: 16%



Site: Saddle Mountain **Elevation:** 846 ft (258 m) **Treatment Date:** 09/2008
Shrubs: 4% Perennial Grass: 10% Total Grass: 57% Bare Ground: 29%



Sagebrush Steppe: Group 4, Mow

(Pre-treatment Cover: Shrub: >25%; Total grass: >25%)

Site: Saddle Mountain **Elevation:** 899 ft (274 m) **Treatment Date:** 11/2008

Shrubs: 6% Perennial Grass: 48% Total Grass: 47% Bare Ground: 23%



Site: Onaqui **Elevation:** 5505 ft (1678 m) **Treatment Date:** 10/2006

Shrubs: 14% Perennial Grass: 21% Total Grass: 22% Bare Ground: 20%



Sagebrush Steppe: Group 4, Herbicide

(Pre-treatment Cover: Shrub: >25%; Total grass: >25%)

Site: Saddle Mountain **Elevation:** 879 ft (268 m) **Treatment Date:** 11/2008

Shrubs: 1% Perennial Grass: 28% Total Grass: 29% Bare Ground: 19%



Site: Saddle Mountain **Elevation:** 879 ft (268 m) **Treatment Date:** 11/2008

Shrubs: 24% Perennial Grass: 35% Total Grass: 40% Bare Ground: 18%



Sagebrush Steppe: Group 4

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total live loading (ton/ac) | | | Standing dead loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|-------|-----------------------------|-------|-------|--------------------------------|------|------|-------------------------------------|---------|---------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARTRW8 | CO | 15* | 30 | 23 | 4 | 68 | 26 | 1,045 | 4,746 | 3,111 | 0.41* | 9.58 | 2.94 | NA | | | 0.0002 | 0.0853 | 0.0331 |
| | FI | <1* | 24 | 3 | 4 | 36 | 18 | 23* | 3,997 | 615 | <0.01* | 1.91 | 0.29 | | | | 0.0001* | 0.0579 | 0.0066 |
| | MO | 2* | 29 | 11 | 3 | 45 | 13 | 727 | 6,268 | 2,817 | 0.02* | 2.33 | 0.81 | | | | 0.0003* | 0.0649 | 0.0219 |
| | TE | 1 | 35 | 24 | 5 | 56 | 25 | 295 | 8,880 | 4,018 | 0.07 | 6.41 | 2.47 | 0.04* | 2.49 | 0.58 | 0.0009 | 0.1696 | 0.0431 |
| CHV18 | CO | <1* | 5 | <1 | 6 | 22 | 14 | 23* | 2,339 | 114 | NA | | | NA | | | NA | | |
| | FI | <1* | 1 | <1 | 4 | 44 | 10 | 227* | 227 | 10 | 0.05* | 0.05 | <0.01 | | | | <0.0001* | <0.0001 | <0.0001 |
| | MO | <1* | 1 | <1 | 4 | 16 | 8 | 45 | 204 | 25 | <0.01* | <0.01 | <0.01 | | | | <0.0001* | <0.0001 | <0.0001 |
| | TE | <1* | 3 | <1 | 5 | 30 | 13 | 23* | 23 | 1 | NA | | | | | | NA | | |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Loading (ton/ac) | | |
|-------------------|-----------|-----------------|-----|------|------------------|------|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Interspace litter | CO | 2 | 32 | 14 | 0.03 | 0.44 | 0.17 |
| | FI | <1* | 14 | 6 | 0.01* | 0.29 | 0.04 |
| | MO | 2 | 30 | 17 | 0.02 | 0.88 | 0.23 |
| | TE | 5 | 22 | 12 | 0.02 | 0.87 | 0.17 |
| Bare ground | CO | 8 | 51 | 20 | NA | | |
| | FI | 7 | 67 | 39 | | | |
| | MO | 3 | 36 | 20 | | | |
| | TE | 8 | 29 | 18 | | | |

NONWOODY FUELS

| | CO | | | FI | | | MO | | | TE | | |
|--|--------|----------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 3 | 56 | 24 | 9 | 51 | 18 | 10 | 66 | 29 | 9 | 64 | 32 |
| Total cover: Annual grass [†] (%) | <1* | 51 | 9 | <1* | 63 | 17 | 1* | 63 | 18 | <1* | 5 | 1 |
| Total cover: Forbs (%) | 1 | 9 | 5 | 2 | 67 | 19 | 2 | 22 | 9 | 1* | 9 | 3 |
| Grass height (in.) | 3* | 9 | 5 | 3* | 12 | 8 | 4 | 12 | 8 | 2* | 10 | 4 |
| Forb height (in.) | 2* | 8 | 6 | 3* | 13 | 4 | 1* | 8 | 3 | 1* | 9 | 2 |
| Live loading (lbs/ac) | 17.91 | 590.93 | 132.31 | 8.95* | 810.28 | 147.15 | 26.86 | 335.75 | 116.44 | 4.48* | 170.11 | 60.39 |
| Dead loading (lbs/ac) | 8.95* | 1,199.76 | 159.67 | 4.48* | 58.20 | 5.84 | 4.48* | 102.96 | 23.83 | 4.48* | 49.24 | 7.90 |
| Total loading (lbs/ac) | 26.86 | 1,790.69 | 291.98 | 13.43 | 868.48 | 152.99 | 31.34 | 438.71 | 140.27 | 8.96 | 219.35 | 68.29 |
| Bulk density (lbs/ft ³) | 0.0041 | 0.1046 | 0.0323 | 0.0013* | 0.0417 | 0.0124 | 0.0035 | 0.0574 | 0.0153 | 0.0050 | 0.0393 | 0.0104 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | | | | |
|-----------------------------|------------------|------|------|-------|------|------|-------|------|------|-------|------|------|
| | CO | | | FI | | | MO | | | TE | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.10 | 0.56 | 0.35 | 0.05 | 0.28 | 0.18 | 0.13 | 1.48 | 0.54 | 0.10 | 0.93 | 0.39 |
| 1.1–3.0 (100-hour) | 0.20 | 1.13 | 0.57 | 0.05* | 1.18 | 0.26 | 0.10 | 1.72 | 0.69 | 0.05* | 1.33 | 0.53 |
| 3.1–9.0 (1000-hour: Sound) | 0.09* | 0.78 | 0.19 | 0.15* | 0.64 | 0.06 | 0.09* | 0.90 | 0.22 | 0.02* | 0.45 | 0.11 |
| 3.1–9.0 (1000-hour: Rotten) | 0.22 | 0.82 | 0.06 | 0.07* | 0.39 | 0.03 | 0.11* | 1.08 | 0.22 | 0.09* | 0.22 | 0.04 |
| Total loading | 0.61 | 3.29 | 1.17 | 0.32 | 2.49 | 0.53 | 0.43 | 5.18 | 1.67 | 0.26 | 2.93 | 1.07 |

Pinyon-Juniper Fuels Guide: 3 Phases, 3 Treatments

User Notes

Site Notes

- Three phases with three treatments represent the SageSTEP Sagebrush/Pinyon-Juniper sites characterized by the Loamy 12–14” ecological type (NRCS 1997).
- General site information:
 - Average annual precipitation ranged between 10.2–15.8 in. (25.9–40.1 cm) averaging 13.5 in. (34.3 cm);
 - Slopes 6–30%, all aspects;
 - ‘Loamy’ soil texture, and soil depths >20 in. (50.8 cm) with minimal stoniness.
- The amount of woodland encroachment suggests these sites have not burned since the late 1800’s (Miller and Tausch 2001). With increased woodland dominance the fire regime has shifted to infrequent, high-intensity fires (Miller et al. 1999).
- Three treatments were employed across the region: control, fire and mechanical (cutting).
- All sites are in active grazing allotments, and all subplots may have been grazed prior to construction of the exclosures at the beginning of the SageSTEP project.
- Site locations, number of subplots and elevation range for data used in tables are as follows:
 - Phase I **Control:** Marking Corral, Seven Mile, South Ruby Mt; 14 subplots; 6565–7464 ft (2001–2275 m)
 Fire: Marking Corral, Seven Mile, South Ruby Mt; 13 subplots; 6575–7336 ft (2004–2236 m)
 Mechanical (Cutting): Marking Corral, Seven Mile; 7 subplots; 6677–7766 ft (2035–2367 m)
 - Phase II **Control:** Marking Corral, Seven Mile, South Ruby Mt; 16 subplots; 6565–7464 ft (2001–2275 m)
 Fire: Marking Corral, Seven Mile, South Ruby Mt; 26 subplots; 6575–7336 ft (2004–2236 m)
 Mechanical (Cutting): Marking Corral, Seven Mile; 20 subplots; 6677–7766 ft (2035–2367 m)
 - Phase III **Control:** Marking Corral, Seven Mile, South Ruby Mt; 18 subplots; 6565–7464 ft (2001–2275 m)
 Fire: Marking Corral, Seven Mile, South Ruby Mt; 16 subplots; 6575–7336 ft (2004–2236 m)
 Mechanical (Cutting): Marking Corral, Seven Mile; 7 subplots; 6677–7766 ft (2035–2367 m)

Guide Notes

1. Phases are organized by **pre-treatment** tree stand cover and understory characteristics (Stebleton and Bunting 2009).
 - Phase 1: Trees are present on the site, but the shrub and herb layer are the dominant influence on ecological processes (hydrologic, nutrient, and energy cycles).
 - Phase 2: Trees are co-dominant with shrub and herb layers. All three layers influence ecological processes.
 - Phase 3: Trees are the dominant vegetation and the primary layer influencing ecological processes.
2. Treatments, abbreviations and treatment objectives:
 - Control (CO): Untreated
 - Fire (FI): Objective was to blacken 100% of the plot area with a low-severity prescribed burn (not all plots met objective).
 - Mechanical (Cutting) (ME): All trees >1.6 ft (0.5 m) were cut at the base with a chainsaw and left on site.
3. The caption above the photos denotes measured percent live cover by fuel stratum for that post-treatment photo.
4. Sampling took place between May and July in 2008, 2009, and 2010. The date of the photo is in the lower right hand corner.
5. Percent bare ground is the only reported measure of fuel continuity.
6. Dominant graminoids: ACHY, ACNE10, ACTH7, BRTE, HECO26, POSE, and PSSPS
7. BRTE is the only annual grass reported.
8. Shrub loadings are restricted by height, long diameter, perpendicular diameter and volume. Refer to Appendix V, 'Pinyon-Juniper', for sample ranges used in this study and R² values.
9. Minimum values presented with an asterisk (*) indicate minimum value when present. Mean value includes all subplots.
10. The designation of "NA" indicates data were not available.
11. Tables of species codes and metric conversions can be found in Appendix I and II.

Pinyon-Juniper: Phase 1, Control

Site: South Ruby Mountain Elevation: 6565 ft (2001 m)

Trees: 1% Shrubs: 31% Perennial Grass: 41% Total Grass: 41% Bare Ground: 28%



Site: South Ruby Mountain Elevation: 6565 ft (2001 m)

Trees: 10% Shrubs: 10% Perennial Grass: 33% Total Grass: 38% Bare Ground: 40%



Pinyon-Juniper: Phase 1, Fire

Site: Marking Corral **Elevation:** 7162 ft (2183 m) **Treatment Date:** 08–09/2006
Trees: <1% Shrubs: 6% Perennial Grass: 12% Total Grass: 12% Bare Ground: 45%



Site: South Ruby Mountain **Elevation:** 6575 ft (2004 m) **Treatment Date:** 10/2008
Trees: 2% Shrubs: 10% Perennial Grass: 34% Total Grass: 39% Bare Ground: 23%



Pinyon-Juniper: Phase 1, Mechanical (Cutting)

Site: Marking Corral **Elevation:** 7247 ft (2209 m) **Treatment Date:** 09/2006
Trees: 0% Shrubs: 20% Perennial Grass: 16% Total Grass: 16% Bare Ground: 25%



06/02/08

Site: Marking Corral **Elevation:** 7247 ft (2209 m) **Treatment Date:** 09/2006
Trees: 1% Shrubs: 15% Perennial Grass: 11% Total Grass: 11% Bare Ground: 40%



06/03/08

Pinyon-Juniper: Phase 1

TREES

| | Treatment | JUOS | | | CELE3 | | | PIMO | | |
|---------------------------------------|-----------|------|-----|------|-------|-----|------|------|-----|------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover (%) | CO | 1* | 30 | 6 | 0 | | | 1* | 4 | 1 |
| | FI | 1* | 3 | 1 | | | | 1* | 2 | <1 |
| | ME | 1* | 2 | 1 | | | | 0 | | |
| Density: <1.6 ft tall (stem/ac) | CO | 0 | | | 23* | 68 | 15 | 23* | 45 | 15 |
| | FI | | | | 23* | 23 | 5 | 23* | 23 | 2 |
| | ME | | | | 23* | 45 | 16 | 23* | 23 | 6 |

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|-------|------------------------|------|------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARAR8 | CO | 0 | | | 0 | | | 68* | 68 | 11 | NA | | | NA | | |
| | FI | | | | | | | 0 | | | | | | | | |
| | ME | | | | | | | 2* | 2 | <1 | | | | | | |
| ARNO4 | CO | 0 | | | 0 | | | 0 | | | 0 | | | 0 | | |
| | FI | *1 | 7 | 1 | 6 | 31 | 15 | 45* | 727 | 210 | 0.01* | 0.48 | 0.12 | 0.0001* | 0.0078 | 0.0006 |
| | ME | 4* | 8 | 3 | 1 | 19 | 10 | 318* | 1,862 | 522 | 0.17* | 0.17 | 0.04 | 0.0023* | 0.0026 | 0.0004 |
| ARTRW8 | CO | 2* | 20 | 7 | 6 | 41 | 17 | 23* | 3,429 | 1,338 | 0.28* | 3.43 | 1.98 | 0.0027* | 0.0607 | 0.0166 |
| | FI | 1* | 5 | 1 | 7 | 43 | 17 | 23* | 1,385 | 383 | 0.28* | 3.43 | 1.98 | 0.0001* | 0.0500 | 0.0049 |
| | ME | 5 | 18 | 13 | 4 | 46 | 17 | 2,135 | 4,042 | 2,722 | 0.01 | 2.62 | 0.47 | 0.0162 | 0.0480 | 0.0326 |
| CHVI8 | CO | 2 | 10 | 6 | 4 | 66 | 12 | 860 | 4,130 | 2,040 | 0.05 | 1.23 | 0.20 | 0.0025 | 0.0275 | 0.0060 |
| | FI | 1* | 7 | 3 | 5 | 18 | 9 | 191 | 4,348 | 1,671 | 0.05* | 1.23 | 0.20 | 0.0002* | 0.0038 | 0.0013 |
| | ME | 1* | 5 | 2 | 4 | 30 | 9 | 263 | 2,391 | 1,066 | <0.01* | 1.35 | 0.23 | 0.0017* | 0.0030 | 0.0009 |
| PUTR2 | CO | 1* | 8 | 2 | 10 | 69 | 33 | 23* | 295 | 61 | 0.15* | 1.38 | 0.63 | 0.0012* | 0.0097 | 0.0013 |
| | FI | 1* | 2 | 1 | 7 | 47 | 15 | 23* | 227 | 58 | <0.01* | 0.09 | 0.03 | 0.0001* | 0.0009 | 0.0002 |
| | ME | 2* | 2 | 1 | 19 | 29 | 21 | 91* | 182 | 39 | 0.01* | 0.05 | 0.03 | 0.0002* | 0.0006 | 0.0001 |

Pinyon-Juniper: Phase 1

NONWOODY FUELS

| | CO | | | FI | | | ME | | |
|--|--------|----------|--------|--------|----------|--------|--------|--------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 8 | 46 | 25 | 1 | 44 | 18 | 11 | 17 | 15 |
| Total cover: Annual grass [†] (%) | 5* | 5 | <1 | 1* | 5 | 1 | 1* | 1 | <1 |
| Total cover: Forbs (%) | 11* | 17 | 4 | 15* | 39 | 15 | 2 | 16 | 8 |
| Grass height (in.) | 5 | 20 | 11 | 3 | 19 | 9 | 6 | 14 | 9 |
| Forb height (in.) | 2 | 12 | 7 | 3 | 15 | 8 | 3 | 5 | 4 |
| Live loading (lbs/ac) | 160.27 | 806.70 | 433.18 | 143.25 | 1,088.74 | 583.14 | 212.20 | 274.87 | 250.84 |
| Dead loading (lbs/ac) | 11.64 | 477.22 | 188.51 | 2.69 | 90.43 | 39.69 | 4.48 | 100.28 | 52.08 |
| Total loading (lbs/ac) | 171.91 | 1,283.92 | 621.69 | 145.94 | 1,179.17 | 622.83 | 216.68 | 375.15 | 302.92 |
| Bulk density (lbs/ft ³) | 0.0108 | 0.0272 | 0.0197 | 0.0084 | 0.0624 | 0.0283 | 0.0084 | 0.0186 | 0.0134 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | |
|-----------------------------|------------------|------|------|-------|------|------|-------|------|------|
| | CO | | | FI | | | ME | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.05 | 0.53 | 0.25 | 0.12 | 0.61 | 0.40 | 0.22 | 0.53 | 0.42 |
| 1.1–3.0 (100-hour) | 0.05 | 0.84 | 0.48 | 0.30 | 1.08 | 0.62 | 0.30 | 1.57 | 0.93 |
| 3.1–9.0 (1000-hour: Sound) | 0.18* | 1.13 | 0.20 | 0.12* | 0.80 | 0.23 | 0.88* | 2.56 | 0.89 |
| 3.1–9.0 (1000-hour: Rotten) | 0 | | | 0 | | | 0 | | |
| Total loading | 0.28 | 2.50 | 0.93 | 0.54 | 2.49 | 1.25 | 1.40 | 4.66 | 2.24 |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Depth (in.) | | | Loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|-------------------|-----------|-----------------|-----|------|-------------|-----|------|------------------|------|------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Tree litter | CO | NA | | | 1.0 | 2.8 | 2.0 | 0.27 | 4.06 | 1.77 | 0.0999 | 0.9614 | 0.4832 |
| | FI | | | | <0.1 | 1.6 | 0.7 | 0.09 | 1.39 | 0.73 | 0.1373 | 1.3048 | 0.6680 |
| | ME | | | | 1.0 | 2.4 | 1.8 | 0.55 | 6.65 | 2.31 | 0.2435 | 1.5483 | 0.5993 |
| Tree duff | CO | NA | | | 0.1 | 1.2 | 0.3 | 0.09 | 0.27 | 0.18 | 0.5993 | 0.7616 | 0.6805 |
| | FI | | | | 0.2 | 0.2 | <0.1 | 0.01 | 0.42 | 0.24 | 0.7804 | 0.9739 | 0.8771 |
| | ME | | | | 0.1 | 0.2 | 0.1 | 0.06 | 0.58 | 0.23 | 0.3871 | 1.3547 | 0.9115 |
| Interspace litter | CO | 1* | 22 | 5 | NA | | | 0.04 | 1.11 | 0.31 | NA | | |
| | FI | 10* | 37 | 17 | | | | 0.02 | 0.18 | 0.10 | | | |
| | ME | 1* | 18 | 10 | | | | 0.07 | 0.21 | 0.14 | | | |
| Bare ground | CO | 23 | 52 | 40 | NA | | | NA | | | NA | | |
| | FI | 19 | 69 | 37 | | | | | | | | | |
| | ME | 25 | 58 | 41 | | | | | | | | | |

Pinyon-Juniper: Phase 2, Control

Site: Marking Corral Elevation: 7054 ft (2150 m)

Trees: 11% Shrubs: 8% Perennial Grass: 5% Total Grass: 5% Bare Ground: 54%



Site: South Ruby Mountain Elevation: 6565 ft (2001 m)

Trees: 12% Shrubs: 8% Perennial Grass: 26% Total Grass: 26% Bare Ground: 51%



Pinyon-Juniper: Phase 2, Fire

Site: Marking Corral **Elevation:** 7162 ft (2183 m) **Treatment Date:** 08–09/2006
Trees: 1% Shrubs: 2% Perennial Grass: 5% Total Grass: 5% Bare Ground: 65%



06/10/08

Site: Marking Corral **Elevation:** 7162 ft (2183 m) **Treatment Date:** 08–09/2006
Trees: 4% Shrubs: 4% Perennial Grass: 9% Total Grass: 9% Bare Ground: 42%



06/03/08

Pinyon-Juniper: Phase 2, Mechanical (Cutting)

Site: Marking Corral **Elevation:** 7247 ft (2209 m) **Treatment Date:** 09/2006
Trees: 0% Shrubs: 10% Perennial Grass: 9% Total Grass: 9% Bare Ground: 22%



05/29/08

Site: Marking Corral **Elevation:** 7247 ft (2209 m) **Treatment Date:** 09/2006
Trees: <1% Shrubs: 5% Perennial Grass: 11% Total Grass: 12% Bare Ground: 39%



05/28/08

Pinyon-Juniper: Phase 2

TREES

| | Treatment | JUOS | | | CELE3 | | | PIMO | | |
|---------------------------------------|-----------|------|-----|------|-------|-----|------|------|-----|------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover (%) | CO | 5* | 44 | 14 | 0 | | | 2* | 24 | 8 |
| | FI | 1* | 14 | 2 | 0 | | | 1* | 12 | 1 |
| | ME | 1* | 1 | <1 | 2* | 4 | <1 | 1* | 1 | <1 |
| Density: <1.6 ft tall (stem/ac) | CO | 0 | | | 23* | 318 | 91 | 23* | 91 | 27 |
| | FI | 0 | | | 23* | 250 | 22 | 23* | 91 | 7 |
| | ME | 0 | | | 23* | 182 | 31 | 23* | 159 | 22 |

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|-------|------------------------|------|------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARAR8 | CO | 2* | 7 | 1 | 6 | 45 | 13 | 23* | 68 | 10 | 0.02* | 0.90 | 0.23 | 0.0080* | 0.0151 | 0.0014 |
| | FI | 0 | | | 0 | | | 0 | | | 0 | | | 0 | | |
| | ME | 1* | 2 | <1 | 4 | 20 | 12 | 159* | 704 | 60 | 0.45* | 0.46 | 0.45 | 0.0147* | 0.0196 | 0.0017 |
| ARNO4 | CO | 1* | 2 | <1 | 7 | 14 | 11 | 23* | 68 | 10 | NA | | | NA | | |
| | FI | 1* | 3 | 1 | 4 | 27 | 12 | 23* | 2,271 | 372 | <0.01* | 1.13 | 0.14 | 0.0022* | 0.0192 | 0.0015 |
| | ME | 2* | 12 | 1 | 6 | 15 | 9 | 23* | 2,907 | 176 | NA | | | NA | | |
| ARTRW8 | CO | 1* | 19 | 6 | 6 | 43 | 16 | 159* | 3,089 | 1,468 | 0.02* | 1.87 | 0.81 | 0.0003* | 0.0262 | 0.0119 |
| | FI | 1* | 10 | 1 | 6 | 37 | 15 | 23* | 1,113 | 184 | 0.01* | 2.11 | 0.36 | 0.0001* | 0.0415 | 0.0025 |
| | ME | 5* | 20 | 11 | 6 | 48 | 17 | 1,158* | 3,792 | 2,181 | 0.51* | 4.50 | 2.06 | 0.0087* | 0.0806 | 0.0296 |
| CHVI8 | CO | 1 | 6 | 2 | <1 | 23 | 9 | 48 | 3,043 | 998 | <0.01 | 0.14 | 0.02 | 0.0001 | 0.0066 | 0.0013 |
| | FI | 1* | 5 | 1 | 2 | 22 | 8 | 48 | 1,882 | 485 | <0.01* | 0.04 | 0.01 | 0.0001* | 0.0025 | 0.0006 |
| | ME | 1* | 3 | 1 | 1 | 21 | 9 | 48 | 3,913 | 778 | <0.01* | 0.17 | 0.02 | 0.0004* | 0.0066 | 0.0008 |
| PUTR2 | CO | 3* | 8 | 1 | 7 | 93 | 28 | 23* | 386 | 67 | 0.05* | 1.34 | 0.36 | 0.0013* | 0.0091 | 0.0010 |
| | FI | 1* | 2 | <1 | 7 | 49 | 18 | 23* | 1,812 | 36 | 0.01* | 0.25 | 0.09 | 0.0009* | 0.0040 | 0.0006 |
| | ME | 1* | 4 | 1 | 7 | 35 | 21 | 68* | 386 | 70 | 0.01* | 0.18 | 0.08 | 0.0003* | 0.0020 | 0.0003 |

Pinyon-Juniper: Phase 2

NONWOODY FUELS

| | CO | | | FI | | | ME | | |
|--|--------|--------|--------|--------|----------|--------|--------|--------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 1 | 30 | 10 | 1* | 44 | 9 | 3 | 19 | 10 |
| Total cover: Annual grass [†] (%) | 1* | 1 | <1 | 2* | 2 | <1 | 1* | 1 | <1 |
| Total cover: Forbs (%) | 2* | 15 | 4 | 5* | 42 | 14 | 2* | 17 | 6 |
| Grass height (in.) | 4 | 13 | 7 | 2 | 15 | 7 | 4 | 11 | 8 |
| Forb height (in.) | 1 | 9 | 4 | 2 | 7 | 4 | 2 | 6 | 4 |
| Live loading (lbs/ac) | 25.96 | 461.10 | 185.93 | 38.50 | 1,452.24 | 325.53 | 29.99 | 296.36 | 170.37 |
| Dead loading (lbs/ac) | 7.16* | 71.63 | 38.44 | 2.69 | 140.57 | 38.67 | 2.69* | 102.96 | 28.65 |
| Total loading (lbs/ac) | 33.12 | 532.73 | 224.37 | 41.19 | 1,592.81 | 364.20 | 32.68 | 399.32 | 199.02 |
| Bulk density (lbs/ft ³) | 0.0032 | 0.0168 | 0.0111 | 0.0050 | 0.1011 | 0.0280 | 0.0057 | 0.0193 | 0.0114 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | |
|-----------------------------|------------------|------|------|-------|------|------|-------|-------|------|
| | CO | | | FI | | | ME | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.07 | 0.44 | 0.28 | 0.13 | 0.51 | 0.31 | 0.31 | 1.98 | 0.71 |
| 1.1–3.0 (100-hour) | 0.15* | 0.84 | 0.34 | 0.10 | 1.48 | 0.67 | 0.25 | 3.00 | 1.56 |
| 3.1–9.0 (1000-hour: Sound) | 0.15* | 1.66 | 0.28 | 0.09* | 0.83 | 0.22 | 0.21 | 10.17 | 3.27 |
| 3.1–9.0 (1000-hour: Rotten) | 0 | | | 0 | | | 0.35* | 0.35 | 0.02 |
| Total loading | 0.37 | 2.94 | 0.90 | 0.32 | 2.82 | 1.20 | 1.12 | 15.50 | 5.56 |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Depth (in.) | | | Loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|-------------------|-----------|-----------------|-----|------|-------------|-----|------|------------------|-------|------|-------------------------------------|---------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Tree litter | CO | NA | | | 1.3 | 2.3 | 1.8 | 2.01 | 18.62 | 6.89 | 0.7117 | 4.4138 | 2.0119 |
| | FI | | | | 0.2 | 1.8 | 0.6 | 0.26 | 5.62 | 2.15 | 0.3621 | 3.9021 | 1.8203 |
| | ME | | | | 0.9 | 2.6 | 1.7 | 1.63 | 9.44 | 4.25 | 0.4870 | 3.3025 | 1.3905 |
| Tree duff | CO | NA | | | 0.1 | 0.6 | 0.2 | 0.17 | 10.58 | 1.89 | 0.7554 | 11.3872 | 2.9178 |
| | FI | | | | <0.1 | 0.4 | 0.1 | 0.09* | 1.71 | 0.61 | 0.4994* | 4.9319 | 2.0519 |
| | ME | | | | <0.01 | 0.6 | 0.1 | 0.06* | 1.20 | 0.66 | 0.8865* | 3.3462 | 2.0810 |
| Interspace litter | CO | 1* | 33 | 10 | NA | | | 0.02 | 0.30 | 0.11 | NA | | |
| | FI | 5 | 41 | 22 | | | | <0.01 | 0.21 | 0.06 | | | |
| | ME | 1* | 26 | 12 | | | | <0.01 | 0.31 | 0.10 | | | |
| Bare ground | CO | 33 | 63 | 48 | NA | | | NA | | | NA | | |
| | FI | 18 | 82 | 44 | | | | | | | | | |
| | ME | 22 | 65 | 42 | | | | | | | | | |

Pinyon-Juniper: Phase 3, Control

Site: Marking Corral Elevation: 7054 ft (2150 m)

Trees: 25% Shrubs: 2% Perennial Grass: 4% Total Grass: 4% Bare Ground: 42%



05/21/08

Site: Marking Corral Elevation: 7054 ft (2150 m)

Trees: 43% Shrubs: 2% Perennial Grass: 2% Total Grass: 2% Bare Ground: 32%



05/21/08

Pinyon-Juniper: Phase 3, Fire

Site: Marking Corral **Elevation:** 7162 ft (2183 m) **Treatment Date:** 08–09/2006
Trees: 4% Shrubs: <1% Perennial Grass: 7% Total Grass: 8% Bare Ground: 52%



06/09/08

Site: South Ruby Mountain **Elevation:** 6575 ft (2004 m) **Treatment Date:** 10/2008
Trees: 10% Shrubs: 1% Perennial Grass: 24% Total Grass: 24% Bare Ground: 27%



08/03/10

Pinyon-Juniper: Phase 3, Mechanical (Cutting)

Site: Marking Corral Elevation: 7247 ft (2209 m) Treatment Date: 09/2006
Trees: 0% Shrubs: 1% Perennial Grass: 5% Total Grass: 5% Bare Ground: 25%



05/29/08

Site: Marking Corral Elevation: 7247 ft (2209 m) Treatment Date: 09/2006
Trees: 0% Shrubs: 8% Perennial Grass: 8% Total Grass: 9% Bare Ground: 22%



05/29/08

Pinyon-Juniper: Phase 3

TREES

| | Treatment | JUOS | | | CELE3 | | | PIMO | | |
|---------------------------------------|-----------|------|-----|------|-------|-----|------|------|-----|------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover (%) | CO | 6 | 56 | 26 | 1* | 4 | <1 | 2* | 40 | 18 |
| | FI | 1* | 12 | 5 | 0 | | | 1* | 12 | 4 |
| | ME | 3* | 19 | 3 | 6* | 18 | 3 | 2* | 5 | 1 |
| Density: <1.6 ft tall (stem/ac) | CO | 0 | | | 23* | 454 | 107 | 23* | 114 | 34 |
| | FI | 0 | | | 23* | 159 | 47 | 23* | 45 | 14 |
| | ME | 91* | 91 | 13 | 23* | 182 | 58 | 23* | 114 | 55 |

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|------|------------------------|-------|-------|-------------------------------------|--------|---------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARAR8 | CO | 0 | | | 0 | | | 0 | | | 0 | | | 0 | | |
| | FI | 0 | | | 0 | | | 0 | | | 0 | | | 0 | | |
| | ME | 1* | 3 | 1 | 4 | 19 | 11 | 227* | 931 | 263 | 0.02* | 0.13 | 0.06 | 0.0008* | 0.0060 | 0.0014 |
| ARNO4 | CO | 2* | 2 | <1 | 6 | 24 | 11 | 23* | 295 | 51 | <0.01* | <0.01 | <0.01 | 0.0001* | 0.0001 | <0.0001 |
| | FI | 1* | 2 | <1 | 3 | 23 | 10 | 45* | 749 | 111 | 0.14* | 0.14 | 0.07 | 0.0039* | 0.0039 | 0.0004 |
| | ME | 0 | | | 8 | 13 | 10 | 45* | 68 | 16 | 0 | | | 0 | | |
| ARTRW8 | CO | 1* | 5 | 1 | 6 | 39 | 17 | 159* | 1,725 | 411 | 0.06* | 0.84 | 0.26 | 0.0008* | 0.0106 | 0.0022 |
| | FI | 1* | 1 | <1 | 6 | 30 | 11 | 23* | 363 | 87 | 0.01* | 0.16 | 0.07 | <0.0001* | 0.0057 | 0.0011 |
| | ME | 1 | 10 | 5 | 5 | 33 | 14 | 454 | 1,408 | 951 | 0.06 | 2.31 | 0.73 | 0.0025 | 0.0496 | 0.0141 |
| CHVI8 | CO | 1* | 2 | <1 | 6 | 17 | 10 | 24 | 1,087 | 360 | <0.01* | 0.02 | <0.01 | 0.0001* | 0.0009 | 0.0001 |
| | FI | 1* | 1 | <1 | 6 | 9 | 7 | 24 | 119 | 56 | <0.01* | <0.01 | <0.01 | 0.0001* | 0.0001 | <0.0001 |
| | ME | 1* | 1 | <1 | 7 | 16 | 11 | 24 | 72 | 40 | <0.01* | <0.01 | <0.01 | <0.0001* | 0.0001 | <0.0001 |
| PUTR2 | CO | 1* | 3 | 1 | 6 | 39 | 19 | 23* | 409 | 95 | 0.04* | 0.36 | 0.16 | 0.0006* | 0.0057 | 0.0011 |
| | FI | 1* | 3 | <1 | 6 | 33 | 16 | 23* | 204 | 33 | <0.01* | 0.19 | 0.07 | 0.0001* | 0.0031 | 0.0006 |
| | ME | 1* | 1 | <1 | 20 | 20 | 20 | 23* | 23 | 3 | 0.02* | 0.02 | 0.02 | 0.0003* | 0.0003 | <0.0001 |

Pinyon-Juniper: Phase 3

NONWOODY FUELS

| | CO | | | FI | | | ME | | |
|--|--------|--------|--------|---------|--------|--------|--------|--------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 1* | 19 | 6 | 2* | 24 | 7 | 3 | 9 | 5 |
| Total cover: Annual grass [†] (%) | 3* | 3 | <1 | 1* | 2 | <1 | 1* | 1 | <1 |
| Total cover: Forbs (%) | 1* | 12 | 1 | 1* | 22 | 5 | 2 | 19 | 9 |
| Grass height (in.) | 3 | 14 | 6 | 4* | 11 | 6 | 5 | 8 | 7 |
| Forb height (in.) | 1* | 6 | 3 | 1 | 13 | 6 | 3 | 8 | 5 |
| Live loading (lbs/ac) | 71.60 | 59.99 | 33.96 | 14.33* | 477.22 | 132.85 | 47.45 | 203.24 | 109.23 |
| Dead loading (lbs/ac) | 2.69* | 25.96 | 5.15 | 2.69* | 326.80 | 39.51 | 11.64* | 11.64 | 2.87 |
| Total loading (lbs/ac) | 74.29 | 85.95 | 39.11 | 17.02 | 804.02 | 172.36 | 59.09 | 214.88 | 112.10 |
| Bulk density (lbs/ft ³) | 0.0018 | 0.0091 | 0.0042 | 0.0024* | 0.0365 | 0.0105 | 0.0027 | 0.0175 | 0.0081 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | |
|-----------------------------|------------------|-------|------|-------|-------|------|-------|-------|------|
| | CO | | | FI | | | ME | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.11 | 1.69 | 0.44 | 0.11 | 1.24 | 0.47 | 0.43 | 1.49 | 0.79 |
| 1.1–3.0 (100-hour) | 0.05 | 1.82 | 0.49 | 0.34 | 1.72 | 0.94 | 1.08 | 2.07 | 1.71 |
| 3.1–9.0 (1000-hour: Sound) | 0.12* | 9.39 | 1.12 | 0.21* | 7.40 | 1.97 | 2.34 | 7.55 | 4.91 |
| 3.1–9.0 (1000-hour: Rotten) | 0 | | | 0 | | | 0.16* | 0.16 | 0.02 |
| Total loading | 0.28 | 12.90 | 2.05 | 0.66 | 10.36 | 3.38 | 4.01 | 11.27 | 7.43 |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Depth (in.) | | | Loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|-------------------|-----------|-----------------|-----|------|-------------|-----|------|------------------|-------|------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Tree litter | CO | NA | | | 0.8 | 2.0 | 1.6 | 3.39 | 18.68 | 8.36 | 1.5483 | 5.2316 | 2.7500 |
| | FI | | | | 0.5 | 2.4 | 0.8 | 0.69 | 11.11 | 5.00 | 1.8042 | 5.6187 | 3.4170 |
| | ME | | | | 1.4 | 2.3 | 1.7 | 4.25 | 11.79 | 8.14 | 4.5670 | 3.9580 | 2.7319 |
| Tree duff | CO | NA | | | 0.1 | 0.6 | 0.2 | 0.31* | 7.76 | 2.54 | 1.4921* | 7.7538 | 3.8623 |
| | FI | | | | <0.1 | 0.8 | 0.1 | 0.02 | 9.03 | 1.87 | 0.2123 | 9.0710 | 4.5414 |
| | ME | | | | <0.1 | 0.5 | 0.1 | 0.64 | 3.05 | 1.71 | 2.9716 | 5.1192 | 3.8810 |
| Interspace litter | CO | 2* | 57 | 14 | NA | | | 0.02* | 0.30 | 0.11 | NA | | |
| | FI | 16* | 61 | 24 | | | | <0.01* | 0.21 | 0.06 | | | |
| | ME | 1* | 27 | 11 | | | | <0.01* | 0.31 | 0.10 | | | |
| Bare ground | CO | 17 | 77 | 51 | NA | | | NA | | | NA | | |
| | FI | 12 | 80 | 38 | | | | | | | | | |
| | ME | 22 | 55 | 40 | | | | | | | | | |

Utah Juniper Fuels Guide: 3 Phases, 4 Treatments

User Notes

Site Notes

- Three phases with four treatments represent the SageSTEP Sagebrush/Utah Juniper sites characterized by the Loamy 12–14” ecological type (NRCS 1997).
- General site information:
 - Average annual precipitation ranges between 12.7–17.5 in. (32.3–44.5 cm) averaging 14.9 in. (37.8 cm);
 - Slopes 3–33%, all aspects;
 - ‘Loamy’ soil texture, and soil depths >20 in. (50.8 cm) with minimal stoniness.
- The amount of woodland encroachment suggests these sites have not burned since the late 1800’s (Miller and Tausch 2001). With increased woodland dominance the fire regime has shifted to infrequent, high-intensity fires (Miller et al. 1999).
- Four treatments were employed across the region: control, fire, mechanical (cutting) and mechanical shredding.
- Onaqui is the only site with an active grazing allotment, which may have been grazed prior to construction of the exclosures at the beginning of the SageSTEP project.
- Site locations, number of subplots and elevation range for data used in tables are as follows:
 - Phase I **Control:** Greenville, Onaqui, Scipio, Stansbury; 19 subplots; 5617–5919 ft (1712–1804 m)
Mechanical Shredding: Greenville, Onaqui, Scipio, Stansbury; 15 subplots; 5558–6024 ft (1704–1768 m)
Fire: Greenville, Onaqui, Scipio, Stansbury; 19 subplots; 5591–5801 ft (1694–1836 m)
Mechanical (Cutting): Greenville, Onaqui, Scipio, Stansbury; 12 subplots; 5696–5856 ft (1736–1785 m)
 - Phase II **Control:** Greenville, Onaqui, Scipio, Stansbury; 23 subplots; 5617–5919 ft (1712–1804 m)
Mechanical Shredding: Greenville, Onaqui, Scipio, Stansbury; 22 subplots; 5558–6024 ft (1704–1768 m)
Fire: Greenville, Onaqui, Scipio, Stansbury; 23 subplots; 5591–5801 ft (1694–1836 m)
Mechanical (Cutting): Greenville, Onaqui, Scipio, Stansbury; 22 subplots; 5696–5856 ft (1736–1785 m)
 - Phase III **Control:** Greenville, Onaqui, Scipio, Stansbury; 20 subplots; 5617–5919 ft (1712–1804 m)
Mechanical Shredding: Greenville, Onaqui, Scipio, Stansbury; 19 subplots; 5558–6024 ft (1704–1768 m)
Fire: Greenville, Onaqui, Scipio, Stansbury; 15 subplots; 5591–5801 ft (1694–1836 m)
Mechanical (Cutting): Greenville, Onaqui, Scipio, Stansbury; 27 subplots; 5696–5856 ft (1736–1785 m)

Guide Notes

1. Phases are organized by **pre-treatment** tree stand cover and understory characteristics (Stebleton and Bunting 2009).
 - Phase 1: Trees are present on the site, but the shrub and herb layer are the dominant influence on ecological processes (hydrologic, nutrient, and energy cycles).
 - Phase 2: Trees are co-dominant with shrub and herb layers. All three layers influence ecological processes.
 - Phase 3: Trees are the dominant vegetation and the primary layer influencing ecological processes.
2. Treatments, abbreviations and treatment objectives:
 - Control (CO): Untreated
 - Mechanical Shredding (BM): All trees in each plot were masticated and the mulch was left on-site.
 - Fire (FI): Objective was to blacken 100% of the plot area with a low-severity prescribed burn (not all plots met objective).
 - Mechanical (Cutting) (ME): All trees >1.6 ft (0.5 m) were cut at the base with a chainsaw and left on site.
3. The caption above the photos denotes measured percent live cover by fuel stratum for that photo.
4. Sampling took place between May and early August in 2008, 2009, and 2010. The date of the photo is in the lower right hand corner.
5. Percent bare ground is the only reported measure of fuel continuity.
6. Dominant graminoids: ACHY, ELEL5, HECO26, PLJA, POSE, PSSPS
7. BRTE is the only annual grass reported.
8. Shrub loadings are restricted by height, long diameter, perpendicular diameter and volume. Refer to Appendix V, 'Utah Juniper', for sample ranges used in this study and R² values.
9. Minimum values presented with an asterisk (*) indicate minimum value when present. Mean value includes all subplots.
10. The designation of "NA" indicates data were not available.
11. Tables of species codes and metric conversions can be found in Appendix I and II.

Utah Juniper: Phase 1, Control

Site: Onaqui Elevation: 5617 ft (1712 m)

Trees: 4% Shrubs: 7% Perennial Grass: 24% Total Grass: 24% Bare Ground: 30%



Site: Scipio Elevation: 5751 ft (1753 m)

Trees: 7% Shrubs: 21% Perennial Grass: 17% Total Grass: 29% Bare Ground: 19%



Utah Juniper: Phase 1, Mechanical Shredding

Site: Onaqui Elevation: 5591 ft (1704 m) Treatment Date: 11/2006

Trees: 0% Shrubs: 3% Perennial Grass: 32% Total Grass: 32% Bare Ground: 18%



05/28/08

Site: Greenville Bench Elevation: 5801 ft (1768 m) Treatment Date: 11/2007

Trees: 1% Shrubs: 14% Perennial Grass: 40% Total Grass: 40% Bare Ground: 26%



07/20/09

Utah Juniper: Phase 1, Fire

Site: Stansbury **Elevation:** 5741 ft (1750 m) **Treatment Date:** 09/2007

Trees: 0% Shrubs: <1% Perennial Grass: 1% Total Grass: 91% Bare Ground: 6%



07/02/09

Site: Greenville Bench **Elevation:** 6024 ft (1836 m) **Treatment Date:** 10/2007

Trees: 0% Shrubs: 7% Perennial Grass: 21% Total Grass: 22% Bare Ground: 30%



07/29/09

Utah Juniper: Phase 1, Mechanical (Cutting)

Site: Scipio Elevation: 5741 ft (1750 m) Treatment Date: 11/2007

Trees: 1% Shrubs: 12% Perennial Grass: 23% Total Grass: 30% Bare Ground: 34%



07/08/09

Site: Stansbury Elevation: 5738 ft (1749 m) Treatment Date: 10/2007

Trees: 1% Shrubs: 28% Perennial Grass: 48% Total Grass: 90% Bare Ground: 4%



06/24/09

Utah Juniper: Phase 1

TREES

| | Treatment | JUOS | | | PIED | | |
|---------------------------------------|-----------|------|-----|------|------|-----|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Total cover (%) | CO | 1 | 22 | 7 | <1* | 7 | 1 |
| | BM | <1* | 1 | <1 | <1* | 1 | <1 |
| | FI | 1* | 3 | <1 | 1* | 1 | <1 |
| | ME | <1* | 1 | <1 | <1* | 1 | <1 |
| Density: <1.6 ft tall (stem/ac) | CO | 23* | 136 | 24 | 23* | 68 | 6 |
| | BM | 23* | 91 | 23 | 23* | 23 | 5 |
| | FI | 0 | | | 23* | 45 | 5 |
| | ME | 23* | 91 | 21 | 23* | 91 | 14 |

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|-------|------------------------|------|------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARTRV | CO | <1* | 30 | 6 | 6 | 47 | 23 | 1,711* | 2,748 | 2,071 | 2.71* | 6.10 | 3.52 | 0.0183* | 0.0617 | 0.0104 |
| | BM | <1* | 2 | <1 | 8 | 26 | 17 | 23* | 318 | 104 | 0.18* | 0.21 | 0.19 | <0.0001* | 0.0034 | 0.0003 |
| | FI | 0 | | | 0 | | | 0 | | | 0 | | | 0 | | |
| | ME | <1* | 20 | 2 | 7 | 45 | 17 | 0 | | | 2.26* | 2.26 | 2.26 | 0.0330* | 0.0330 | 0.0027 |
| ARTRW8 | CO | 6* | 22 | 10 | 6 | 55 | 19 | 1,181* | 4,178 | 1,649 | 0.77* | 5.90 | 2.67 | 0.0118* | 0.0564 | 0.0246 |
| | BM | 3* | 13 | 5 | 6 | 51 | 18 | 91* | 3,475 | 1,619 | 0.14* | 2.71 | 1.04 | 0.0050* | 0.0356 | 0.0138 |
| | FI | <1* | 4 | 1 | 6 | 33 | 16 | 23* | 1,067 | 336 | 0.02* | 0.34 | 0.10 | <0.0001* | 0.0049 | 0.0006 |
| | ME | 1* | 31 | 13 | 6 | 52 | 22 | 1,408 | 4,156 | 2,589 | 0.57* | 7.68 | 3.29 | 0.0003* | 0.0032 | 0.0002 |
| CHVI8 | CO | <1* | 9 | 1 | 6 | 27 | 11 | 24* | 2,826 | 681 | <0.01* | 0.11 | 0.01 | 0.0010* | 0.0124 | 0.0010 |
| | BM | <1* | 6 | 1 | 6 | 18 | 10 | 24* | 4,782 | 599 | <0.01* | 0.31 | 0.03 | 0.0010* | 0.0124 | 0.0010 |
| | FI | <1* | 5 | 1 | 6 | 17 | 11 | 24* | 3,043 | 637 | <0.01* | 0.20 | 0.04 | 0.0001* | 0.0079 | 0.0012 |
| | ME | <1* | 13 | 3 | 6 | 18 | 10 | 167 | 7,609 | 2,534 | 0.18* | 0.55 | 0.12 | 0.0057* | 0.0233 | 0.0029 |
| PUTR2 | CO | 9* | 18 | 4 | 10 | 78 | 39 | 295* | 636 | 110 | 0.40* | 2.50 | 1.14 | 0.0052* | 0.0137 | 0.0020 |
| | BM | 9* | 21 | 4 | 8 | 82 | 33 | 159* | 1,226 | 575 | 0.97* | 8.26 | 3.72 | 0.0123* | 0.0470 | 0.0068 |
| | FI | <1* | <1 | <1 | 6 | 7 | 7 | 45* | 250 | 100 | 0.01* | 0.03 | 0.01 | <0.0001 | 0.0003 | 0.0001 |
| | ME | <1* | 8 | 1 | 24 | 59 | 40 | 227* | 227 | 19 | 0.67* | 0.67 | 0.67 | 0.0048* | 0.0048 | 0.0004 |

NONWOODY FUELS

| | CO | | | BM | | | FI | | | ME | | |
|--|--------|--------|--------|--------|--------|--------|--------|----------|--------|--------|--------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 12 | 51 | 24 | 16 | 55 | 33 | 1 | 37 | 14 | 11 | 48 | 23 |
| Total cover: Annual grass [†] (%) | <1* | 41 | 10 | <1* | 52 | 12 | <1* | 90 | 34 | <1* | 42 | 10 |
| Total cover: Forbs (%) | <1 | 24 | 9 | 1 | 15 | 6 | 6 | 54 | 21 | 1* | 17 | 7 |
| Grass height (in.) | 5 | 13 | 9 | 6 | 18 | 13 | 5 | 20 | 12 | 5 | 13 | 10 |
| Forb height (in.) | 2 | 8 | 4 | 1 | 8 | 4 | 1 | 14 | 7 | 2 | 7 | 4 |
| Live loading (lbs/ac) | 48.35 | 590.92 | 221.15 | 88.64 | 686.73 | 396.85 | 85.95 | 1,740.54 | 679.30 | 67.15 | 597.19 | 211.15 |
| Dead loading (lbs/ac) | 0.01 | 0.16 | 0.05 | 9.85* | 212.20 | 71.21 | 13.43* | 13.43 | 1.21 | 4.48 | 119.08 | 52.99 |
| Total loading (lbs/ac) | 48.36 | 591.08 | 221.20 | 98.49 | 898.93 | 468.06 | 99.38 | 1,753.97 | 680.51 | 71.63 | 716.27 | 264.14 |
| Bulk density (lbs/ft ³) | 0.0023 | 0.0282 | 0.0140 | 0.0084 | 0.0239 | 0.0166 | 0.0042 | 0.0321 | 0.0174 | 0.0049 | 0.0198 | 0.0116 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | | | | |
|-----------------------------|------------------|------|------|-------|------|------|-------|------|------|-------|------|------|
| | CO | | | BM | | | FI | | | ME | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.09 | 0.45 | 0.29 | 0.13 | 0.76 | 0.36 | 0.01 | 0.58 | 0.15 | 0.17 | 0.69 | 0.39 |
| 1.1–3.0 (100-hour) | 0.10 | 1.48 | 0.58 | 0.15 | 2.85 | 0.84 | 0.10* | 1.43 | 0.28 | 0.20 | 2.31 | 0.93 |
| 3.1–9.0 (1000-hour: Sound) | 0.09* | 2.33 | 0.23 | 0.05* | 1.16 | 0.11 | 0.12* | 0.99 | 0.16 | 0.15* | 2.96 | 1.12 |
| 3.1–9.0 (1000-hour: Rotten) | 0.07* | 0.27 | 0.03 | 0.13* | 1.16 | 0.11 | 0 | | | 0 | | |
| Total loading | 0.35 | 4.53 | 1.13 | 0.46 | 3.31 | 1.42 | 0.23 | 3.00 | 0.59 | 0.52 | 5.96 | 2.44 |

Utah Juniper: Phase 1

LITTER and DUFF

| | Treatment | Total cover (%) | | | Depth (in.) | | | Loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|-------------------|-----------|-----------------|-----|------|-------------|-----|------|------------------|------|-------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Tree litter | CO | NA | | | 0.4 | 2.0 | 1.1 | 0.22 | 6.88 | 2.01 | 0.3371 | 2.2412 | 0.9440 |
| | BM | | | | 0.6 | 1.8 | 1.0 | 0.69 | 3.94 | 2.19 | 0.5681 | 2.0290 | 1.2493 |
| | FI | | | | 0.1* | 0.5 | 0.2 | 0.06* | 1.39 | 0.36 | 0.3871* | 1.6232 | 0.5145 |
| | ME | | | | 0.6 | 1.5 | 1.1 | 0.38 | 4.92 | 2.34 | 0.3746 | 1.9166 | 1.0920 |
| Tree duff | CO | NA | | | 0 | | | 0 | | | 0 | | |
| | BM | | | | | | | | | | | | |
| | FI | | | | | | | | | | | | |
| | ME | | | | | | | | | | | | |
| Interspace litter | CO | 6 | 26 | 15 | NA | | | <0.01 | 0.11 | 0.03 | NA | | |
| | BM | 4 | 25 | 13 | | | | 0.01* | 0.04 | 0.02 | | | |
| | FI | 1* | 32 | 12 | | | | <0.01* | 0.04 | <0.01 | | | |
| | ME | 4 | 24 | 14 | | | | <0.01 | 0.04 | 0.02 | | | |
| Bare ground | CO | 7 | 50 | 26 | NA | | | NA | | | NA | | |
| | BM | 5 | 41 | 25 | | | | | | | | | |
| | FI | 2 | 53 | 24 | | | | | | | | | |
| | ME | 4 | 47 | 28 | | | | | | | | | |

Utah Juniper: Phase 2

TREES

| | Treatment | JUOS | | | PIED | | |
|---------------------------------------|-----------|------|-----|------|------|-----|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Total cover (%) | CO | 3 | 30 | 14 | 1* | 16 | 3 |
| | BM | <1* | 1 | <1 | <1* | 1 | <1 |
| | FI | 1* | 4 | <1 | <1* | 3 | <1 |
| | ME | <1* | 3 | 1 | <1* | <1 | <1 |
| Density: <1.6 ft tall (stem/ac) | CO | 23* | 91 | 17 | 23* | 136 | 15 |
| | BM | 23* | 136 | 38 | 23* | 91 | 11 |
| | FI | 23* | 45 | 5 | 23* | 45 | 4 |
| | ME | 23* | 318 | 61 | 23* | 23 | 3 |

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total loading (ton/ac) | | | Bulk density (lbs/ft³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|--------|-------|------------------------|------|------|------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARTRV | CO | 11* | 20 | 3 | 7 | 49 | 23 | 1,635* | 2,112 | 356 | 0.44* | 5.85 | 1.67 | 0.0089* | 0.0597 | 0.0050 |
| | BM | 1* | 8 | 1 | 7 | 36 | 22 | 45* | 568 | 63 | 0.23* | 1.75 | 0.84 | 0.0020* | 0.0164 | 0.0018 |
| | FI | <1* | <1 | <1 | 0 | | | 23* | 23 | 1 | 0 | | | 0 | | |
| | ME | 1* | 4 | 1 | 10 | 43 | 24 | 68* | 613 | 49 | 0.04* | 0.73 | 0.34 | 0.0005* | 0.0060 | 0.0006 |
| ARTRW8 | CO | 1* | 24 | 6 | 6 | 52 | 20 | 522* | 2,067 | 940 | 0.20* | 5.99 | 1.65 | 0.0047* | 0.0565 | 0.0155 |
| | BM | 1* | 12 | 5 | 6 | 46 | 17 | 409* | 3,452 | 1,048 | 0.02* | 4.94 | 1.43 | 0.0002* | 0.0464 | 0.0133 |
| | FI | <1* | 5 | 1 | 5 | 51 | 18 | 23* | 1,204 | 283 | 0.01* | 1.02 | 0.25 | <0.0001* | 0.0163 | 0.0029 |
| | ME | 1* | 21 | 8 | 6 | 57 | 20 | 272* | 3,407 | 1,695 | 0.22* | 4.21 | 1.83 | 0.0018* | 0.0498 | 0.0205 |
| CHVI8 | CO | <1* | 7 | 1 | 1 | 20 | 10 | 24* | 2,391 | 666 | <0.01* | 0.30 | 0.02 | 0.0003* | 0.0054 | 0.0005 |
| | BM | <1* | 6 | 1 | 6 | 20 | 9 | 24* | 6,087 | 717 | 0.01* | 0.30 | 0.02 | <0.0001* | 0.0092 | 0.0004 |
| | FI | <1* | 6 | 1 | 6 | 18 | 10 | 24* | 2,826 | 823 | 0.01* | 0.15 | 0.03 | 0.0002* | 0.0051 | 0.0009 |
| | ME | 1* | 9 | 2 | 4 | 20 | 11 | 24* | 1,0435 | 1,526 | 0.12* | 0.40 | 0.06 | 0.0037* | 0.0131 | 0.0012 |
| PUTR2 | CO | 3* | 8 | 1 | 7 | 71 | 33 | 136* | 363 | 52 | 0.03* | 0.69 | 0.18 | 0.0003* | 0.0045 | 0.0003 |
| | BM | 4* | 19 | 2 | 9 | 86 | 35 | 91* | 386 | 55 | 0.05* | 4.92 | 1.98 | 0.0003* | 0.0151 | 0.0024 |
| | FI | 0 | | | 7 | 12 | 9 | 45* | 159 | 19 | 0 | | | 0 | | |
| | ME | 2* | 3 | <1 | 16 | 71 | 39 | 23* | 136 | 19 | 0.07* | 1.20 | 0.50 | 0.0009* | 0.0060 | 0.0004 |

Utah Juniper: Phase 2

NONWOODY FUELS

| | CO | | | BM | | | FI | | | ME | | |
|--|--------|--------|--------|--------|----------|--------|--------|----------|--------|--------|--------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 1 | 42 | 18 | 13 | 52 | 30 | 4 | 49 | 18 | 9 | 55 | 25 |
| Total cover: Annual grass [†] (%) | 1* | 33 | 6 | <1* | 47 | 11 | <1* | 73 | 16 | <1* | 50 | 17 |
| Total cover: Forbs (%) | <1 | 28 | 9 | 1 | 16 | 6 | 1 | 36 | 16 | <1 | 27 | 9 |
| Grass height (in.) | 3 | 11 | 7 | 5 | 17 | 11 | 3 | 17 | 9 | 6 | 17 | 11 |
| Forb height (in.) | 1 | 10 | 3 | 1 | 6 | 3 | 2 | 11 | 5 | 2 | 8 | 5 |
| Live loading (lbs/ac) | 2.69 | 554.22 | 138.82 | 59.09 | 1,055.61 | 414.59 | 18.80 | 1,084.26 | 337.66 | 39.40 | 725.23 | 319.23 |
| Dead loading (lbs/ac) | 4.48 | 273.97 | 81.10 | 19.70* | 162.95 | 62.84 | 9.85* | 9.85 | 0.82 | 2.69 | 232.79 | 59.69 |
| Total loading (lbs/ac) | 7.17 | 828.19 | 219.92 | 78.79 | 1,218.56 | 477.43 | 28.65 | 1,094.11 | 338.48 | 42.09 | 958.02 | 378.92 |
| Bulk density (lbs/ft ³) | 0.0024 | 0.0227 | 0.0108 | 0.0060 | 0.0484 | 0.0198 | 0.0016 | 0.0280 | 0.0130 | 0.0026 | 0.0274 | 0.0147 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | | | | |
|-----------------------------|------------------|------|------|-------|------|------|-------|------|-------|-------|-------|------|
| | CO | | | BM | | | FI | | | ME | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.04 | 0.47 | 0.29 | 0.12 | 0.96 | 0.50 | 0.02 | 0.56 | 0.27 | 0.10 | 1.26 | 0.59 |
| 1.1–3.0 (100-hour) | 0.15 | 1.48 | 0.58 | 0.15 | 2.76 | 1.04 | 0.05* | 1.62 | 0.54 | 0.64 | 5.46 | 2.20 |
| 3.1–9.0 (1000-hour: Sound) | 0.07* | 1.05 | 0.10 | 0.15* | 2.49 | 0.45 | 0.09* | 0.99 | 0.29 | 0.09 | 6.10 | 2.37 |
| 3.1–9.0 (1000-hour: Rotten) | 0.13* | 0.13 | 0.01 | 0.07* | 1.05 | 0.09 | 0.09* | 0.09 | <0.01 | 0.07* | 0.69 | 0.03 |
| Total loading | 0.39 | 3.13 | 0.98 | 0.49 | 7.26 | 2.08 | 0.25 | 3.26 | 1.10 | 0.90 | 13.51 | 5.19 |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Depth (in.) | | | Loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|-------------------|-----------|-----------------|-----|------|-------------|-----|------|------------------|-------|-------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Tree litter | CO | NA | | | 1.6 | 5.4 | 3.5 | 1.76 | 8.55 | 5.33 | 1.0800 | 4.1828 | 2.1261 |
| | BM | | | | 0.4 | 1.9 | 1.1 | 1.15 | 14.29 | 3.81 | 0.7741 | 6.0619 | 1.9475 |
| | FI | | | | 0.2* | 1.6 | 0.5 | 0.15* | 6.17 | 1.84 | 0.5431* | 3.2151 | 1.5360 |
| | ME | | | | 0.7 | 1.6 | 1.2 | 0.45 | 8.81 | 4.65 | 0.2060 | 3.7395 | 2.2023 |
| Tree duff | CO | NA | | | <0.1 | 0.1 | <0.1 | 0.29* | 1.24 | 0.07 | 4.0080* | 4.0080 | 0.1743 |
| | BM | | | | 0 | | | 0 | | | 0 | | |
| | FI | | | | | | | | | | | | |
| | ME | | | | | | | | | | | | |
| Interspace litter | CO | 5 | 25 | 13 | NA | | | <0.01 | 0.10 | 0.03 | NA | | |
| | BM | 3 | 25 | 12 | | | | <0.01* | 0.12 | 0.02 | | | |
| | FI | 2 | 26 | 15 | | | | <0.01* | 0.02 | <0.01 | | | |
| | ME | 2 | 17 | 10 | | | | <0.01 | 0.04 | 0.01 | | | |
| Bare ground | CO | 7 | 53 | 34 | NA | | | NA | | | NA | | |
| | BM | 2 | 47 | 25 | | | | | | | | | |
| | FI | 6 | 57 | 33 | | | | | | | | | |
| | ME | 2 | 43 | 23 | | | | | | | | | |

Utah Juniper: Phase 2, Control

Site: Onaqui Elevation: 5617 ft (1712 m)

Trees: 6% Shrubs: 5% Perennial Grass: 14% Total Grass: 14% Bare Ground: 38%



Site: Stansbury Elevation: 5738 ft (1749 m)

Trees: 19% Shrubs: 3% Perennial Grass: 25% Total Grass: 58% Bare Ground: 14%



Utah Juniper: Phase 2, Mechanical Shredding

Site: Onaqui **Elevation:** 5591 ft (1704 m) **Treatment Date:** 11/2006

Trees: 1% Shrubs: 11% Perennial Grass: 26% Total Grass: 32% Bare Ground: 26%



Site: Scipio **Elevation:** 5558 ft (1694 m) **Treatment Date:** 11/2007

Trees: 0% Shrubs: 7% Perennial Grass: 38% Total Grass: 42% Bare Ground: 36%



Utah Juniper: Phase 2, Fire

Site: Stansbury **Elevation:** 5741 ft (1750 m) **Treatment Date:** 09/2007

Trees: 0% Shrubs: <1% Perennial Grass: 49% Total Grass: 91% Bare Ground: 6%



Site: Scipio **Elevation:** 5715 ft (1742 m) **Treatment Date:** 10/2007

Trees: 0% Shrubs: 2% Perennial Grass: 22% Total Grass: 23% Bare Ground: 20%



Utah Juniper: Phase 2, Mechanical (Cutting)

Site: Greenville Bench **Elevation:** 5856 ft (1785 m) **Treatment Date:** 11/2007
Trees: 0% **Shrubs:** 15% **Perennial Grass:** 19% **Total Grass:** 20% **Bare Ground:** 29%



Site: Stansbury **Elevation:** 5738 ft (1749 m) **Treatment Date:** 10/2007
Trees: 1% **Shrubs:** 4% **Perennial Grass:** 55% **Total Grass:** 96% **Bare Ground:** 4%



Utah Juniper: Phase 3, Control

Site: Greenville Bench **Elevation:** 5919 ft (1804 m)

Trees: 17% Shrubs: 5% Perennial Grass: 1% Total Grass: 1% Bare Ground: 60%



Site: Scipio **Elevation:** 5751 ft (1753 m)

Trees: 38% Shrubs: 1% Perennial Grass: 3% Total Grass: 4% Bare Ground: 54%



Utah Juniper: Phase 3, Mechanical Shredding

Site: Onaqui **Elevation:** 5591 ft (1704 m) **Treatment Date:** 11/2006
Trees: 0% **Shrubs:** 0% **Perennial Grass:** 4% **Total Grass:** 5% **Bare Ground:** 33%



Site: Stansbury **Elevation:** 5699 ft (1737 m) **Treatment Date:** 10/2007
Trees: <1% **Shrubs:** 7% **Perennial Grass:** 53% **Total Grass:** 84% **Bare Ground:** 5%



Utah Juniper: Phase 3, Fire

Site: Stansbury **Elevation:** 5741 ft (1750 m) **Treatment Date:** 09/2007
Trees: 0% Shrubs: 0% Perennial Grass: 32% Total Grass: 65% Bare Ground: 14%



07/07/09

Site: Greenville Bench **Elevation:** 6024 ft (1836 m) **Treatment Date:** 10/2007
Trees: 20% Shrubs: 4% Perennial Grass: 4% Total Grass: 4% Bare Ground: 31%



07/29/09

Utah Juniper: Phase 3, Mechanical (Cutting)

Site: Greenville Bench **Elevation:** 5856 ft (1785 m) **Treatment Date:** 11/2007
Trees: 1% **Shrubs:** 1% **Perennial Grass:** 5% **Total Grass:** 6% **Bare Ground:** 36%



Site: Stansbury **Elevation:** 5738 ft (1749 m) **Treatment Date:** 10/2007
Trees: 1% **Shrubs:** 13% **Perennial Grass:** 54% **Total Grass:** 79% **Bare Ground:** 5%



Utah Juniper: Phase 3 TREES

| | Treatment | JUOS | | | PIED | | |
|---------------------------------------|-----------|------|-----|------|------|-----|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Total cover (%) | CO | 5 | 49 | 26 | 1* | 30 | 7 |
| | BM | <1* | 2 | <1 | <1* | <1 | <1 |
| | FI | <1* | 6 | 2 | 5 | 15 | 2 |
| | ME | <1* | 1 | <1 | <1* | <1 | <1 |
| Density: <1.6 ft tall (stem/ac) | CO | 23* | 68 | 25 | 23* | 91 | 18 |
| | BM | 23* | 91 | 24 | 45* | 45 | 4 |
| | FI | 23* | 45 | 8 | 0 | | |
| | ME | 23* | 341 | 78 | 23* | 90 | 20 |

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|------|------------------------|------|-------|-------------------------------------|--------|---------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARTRV | CO | 2* | 5 | 1 | 6 | 35 | 16 | 250* | 909 | 154 | 0.01* | 0.45 | 0.23 | 0.0003* | 0.0107 | 0.0014 |
| | BM | 1* | 6 | 1 | 10 | 37 | 22 | 136* | 682 | 119 | 0.06* | 1.02 | 0.38 | 0.0009* | 0.0124 | 0.0017 |
| | FI | 0 | | | 0 | | | 0 | | | 0 | | | 0 | | |
| | ME | 2* | 8 | 2 | 6 | 57 | 23 | 182* | 1,431 | 273 | 0.27* | 1.26 | 0.55 | 0.0023* | 0.0160 | 0.0031 |
| ARTRW8 | CO | <1* | 6 | 2 | 6 | 41 | 16 | 114* | 681 | 670 | 0.01* | 1.68 | 0.45 | 0.0014* | 0.0476 | 0.0071 |
| | BM | <1* | 6 | 2 | 7 | 37 | 15 | 23* | 1,408 | 411 | 0.08* | 1.32 | 0.38 | 0.0007* | 0.0175 | 0.0038 |
| | FI | <1* | 3 | 1 | 6 | 43 | 15 | 45* | 454 | 102 | 0.02* | 0.38 | 0.15 | 0.0003* | 0.0073 | 0.0023 |
| | ME | <1 | 10 | 1 | 6 | 39 | 16 | 23* | 3,293 | 249 | 0.01 | 1.80 | 0.31 | 0.0003 | 0.0244 | 0.0019 |
| CHVI8 | CO | <1* | 2 | <1 | 5 | 20 | 8 | 24* | 1,344 | 247 | <0.01* | 1.14 | <0.01 | 0.0001* | 0.0001 | <0.0001 |
| | BM | <1* | 1 | <1 | 6 | 34 | 11 | 24* | 538 | 124 | <0.01* | 0.03 | <0.01 | <0.0001* | 0.0011 | 0.0001 |
| | FI | <1* | 1 | <1 | 7 | 20 | 11 | 24* | 215 | 151 | <0.01* | 0.01 | <0.01 | <0.0001* | 0.0002 | <0.0001 |
| | ME | <1* | 3 | <1 | 6 | 23 | 12 | 24* | 2,609 | 515 | <0.01* | 0.31 | <0.01 | <0.0001* | 0.0136 | 0.0004 |
| PUTR2 | CO | 1* | 6 | 1 | 18 | 24 | 22 | 45* | 114 | 8 | 0.04* | 0.06 | 0.04 | 0.0009* | 0.0009 | 0.0005 |
| | BM | 1* | 5 | 1 | 10 | 55 | 20 | 23* | 114 | 24 | 0.02* | 0.24 | 0.12 | 0.0004* | 0.0036 | 0.0005 |
| | FI | 0 | | | 0 | | | 45* | 45 | 6 | 0 | | | 0 | | |
| | ME | <1* | 15 | 2 | 9 | 126 | 41 | 23* | 636 | 103 | 0.01* | 2.46 | 0.01 | 0.0001* | 0.0128 | 0.0015 |

NONWOODY FUELS

| | CO | | | BM | | | FI | | | ME | | |
|--|--------|--------|--------|--------|----------|--------|--------|----------|--------|--------|----------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 0 | 27 | 9 | 3 | 53 | 22 | 3 | 46 | 15 | 5 | 60 | 28 |
| Total cover: Annual grass [†] (%) | <1* | 23 | 4 | <1* | 54 | 17 | <1* | 49 | 14 | <1* | 54 | 21 |
| Total cover: Forbs (%) | 1 | 21 | 7 | 2 | 15 | 6 | 5 | 42 | 19 | 3 | 31 | 10 |
| Grass height (in.) | 3 | 10 | 6 | 2 | 17 | 10 | 3 | 19 | 8 | 1 | 19 | 8 |
| Forb height (in.) | 1 | 5 | 3 | 1 | 11 | 4 | 1 | 17 | 6 | <1 | 17 | 4 |
| Live loading (lbs/ac) | 2.69 | 340.85 | 72.95 | 33.13 | 882.81 | 351.72 | 51.93 | 1,152.30 | 309.06 | 25.96 | 1,195.28 | 272.86 |
| Dead loading (lbs/ac) | 2.69 | 160.27 | 25.58 | 4.48* | 185.34 | 23.08 | 0 | | | 4.48 | 124.45 | 35.68 |
| Total loading (lbs/ac) | 5.38 | 501.12 | 98.53 | 37.61 | 1,068.15 | 374.80 | 51.93 | 1,152.30 | 309.06 | 30.44 | 1,319.73 | 308.54 |
| Bulk density (lbs/ft ³) | 0.0014 | 0.0190 | 0.0073 | 0.0044 | 0.1178 | 0.0200 | 0.0037 | 0.0514 | 0.0121 | 0.0056 | 0.0313 | 0.0134 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | | | | |
|-----------------------------|------------------|------|-------|-------|-------|------|-------|------|------|-------|-------|------|
| | CO | | | BM | | | FI | | | ME | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.09 | 0.71 | 0.29 | 0.12 | 1.24 | 0.63 | 0.10 | 0.83 | 0.48 | 0.20 | 2.72 | 0.97 |
| 1.1–3.0 (100-hour) | 0.05 | 1.97 | 0.55 | 0.34 | 2.51 | 1.16 | 0.15 | 1.92 | 0.81 | 0.20 | 7.82 | 2.14 |
| 3.1–9.0 (1000-hour: Sound) | 0.12* | 3.99 | 0.61 | 0.09* | 6.49 | 1.42 | 0.07* | 1.00 | 0.38 | 0.07* | 13.39 | 4.11 |
| 3.1–9.0 (1000-hour: Rotten) | 0.09* | 0.09 | <0.01 | 0.11* | 0.81 | 0.15 | 0.09* | 0.29 | 0.02 | 0.07* | 1.20 | 0.10 |
| Total loading | 0.35 | 6.76 | 1.46 | 0.66 | 11.05 | 3.36 | 0.41 | 4.04 | 1.69 | 0.54 | 25.13 | 7.32 |

Utah Juniper: Phase 3

LITTER and DUFF

| | Treatment | Total cover (%) | | | Depth (in.) | | | Loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|-------------------|-----------|-----------------|-----|------|-------------|-----|------|------------------|-------|-------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Tree litter | CO | NA | | | 0.7 | 2.1 | 1.3 | 4.77 | 12.54 | 8.59 | 2.2038 | 5.1629 | 3.6749 |
| | BM | | | | 0.7 | 1.7 | 1.1 | 2.82 | 7.29 | 5.63 | 2.1913 | 4.2702 | 2.9720 |
| | FI | | | | 0.1 | 1.4 | 0.7 | 0.15 | 11.80 | 4.95 | 1.0800 | 6.8797 | 3.6006 |
| | ME | | | | 0.6 | 2.2 | 1.3 | 2.21 | 15.26 | 7.27 | 1.1050 | 4.7009 | 3.6221 |
| Tree duff | CO | NA | | | 0 | | | 0 | | | 0 | | |
| | BM | | | | | | | | | | | | |
| | FI | | | | | | | | | | | | |
| | ME | | | | | | | | | | | | |
| Interspace litter | CO | 4 | 20 | 12 | NA | | | <0.01 | 0.05 | 0.01 | NA | | |
| | BM | 2 | 19 | 12 | | | | <0.01 | 0.04 | 0.01 | | | |
| | FI | 2 | 31 | 17 | | | | <0.01 | 0.03 | <0.01 | | | |
| | ME | 2 | 20 | 10 | | | | <0.01 | 0.07 | 0.02 | | | |
| Bare ground | CO | 13 | 60 | 38 | NA | | | NA | | | NA | | |
| | BM | 4 | 46 | 26 | | | | | | | | | |
| | FI | 7 | 52 | 27 | | | | | | | | | |
| | ME | 1 | 43 | 22 | | | | | | | | | |

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Western Juniper Fuels Guide: 3 Phases, 3 Treatments

User Notes

Site Notes

- Three phases with three treatments represent the SageSTEP Sagebrush/Western Juniper sites characterized by the Loamy 12–14” ecological type (NRCS 1997).
- General site information:
 - Average annual precipitation ranges between 10.2–19.4 in. (25.9–49.3 cm) averaging 14.4 in. (36.6 cm);
 - Slopes 0–41%, all aspects,
 - ‘Loamy’ soil texture, and soil depths >20 in. (50.8 cm) with minimal stoniness.
- The historical fire return interval on these sites was 10–50+ years with low- to moderate-severity fires (Miller and Rose 1999, Miller et al. 1999). The amount of woodland encroachment suggests that these sites have not burned since the late 1800’s (Miller and Tausch 2001). With increased woodland dominance the fire regime has shifted to infrequent, high-intensity fires (Miller et al. 1999).
- Three treatments were employed across the region: control, fire and mechanical (cutting).
- Bridge Creek is the only site without an active grazing allotment and has not been grazed. All other subplots may have been grazed prior to construction of the exclosures at the beginning of the SageSTEP project.
- Site locations, number of subplots and elevation range for data used in tables are as follows:
 - Phase I **Control:** Blue Mt, Bridge Creek, Devine Ridge, Walker Butte; 12 subplots; 4616–5020 ft (871–1530 m)
 Fire: Blue Mt, Bridge Creek, Devine Ridge, Walker Butte; 13 subplots; 2943–4967 ft (897–1514 m)
 Mechanical (Cutting): Blue Mt, Bridge Creek, Devine Ridge, Walker Butte; 12 subplots; 2838–5180 ft (865–1579 m)
 - Phase II **Control:** Blue Mt, Bridge Creek, Devine Ridge, Walker Butte; 23 subplots; 2858–5020 ft (1407–1530 m)
 Fire: Blue Mt, Bridge Creek, Devine Ridge, Walker Butte; 30 subplots; 2943–4967 ft (897–1514 m)
 Mechanical (Cutting): Blue Mt, Bridge Creek, Devine Ridge, Walker Butte; 23 subplots; 2838–5180 ft (865–1579 m)
 - Phase III **Control:** Blue Mt, Bridge Creek, Devine Ridge, Walker Butte; 28 subplots; 2858–5020 ft (1407–1530 m)
 Fire: Blue Mt, Bridge Creek, Devine Ridge, Walker Butte; 18 subplots; 2943–4967 ft (897–1514 m)
 Mechanical (Cutting): Blue Mt, Bridge Creek, Devine Ridge, Walker Butte; 23 subplots; 2838–5180 ft (865–1579 m)

Guide Notes

1. Phases are organized by **pre-treatment** tree stand cover and understory characteristics (Stebleton and Bunting 2009).
 - Phase 1: Trees are present on the site, but the shrub and herb layer are the dominant influence on ecological processes (hydrologic, nutrient, and energy cycles).
 - Phase 2: Trees are co-dominant with shrub and herb layers. All three layers influence ecological processes.
 - Phase 3: Trees are the dominant vegetation and the primary layer influencing ecological processes.
2. Treatments, abbreviations and treatment objectives:
 - Control (CO): Untreated
 - Fire (FI): Objective was to blacken 100% of the plot area with a low-severity prescribed burn (not all plots met objective).
 - Mechanical (Cutting) (ME): All trees >1.6 ft (0.5 m) were cut at the base with a chainsaw and left on site.
3. The caption above the photos denotes measured percent live cover by fuel stratum for that photo.
4. Sampling took place between May and early August in 2008, 2009, and 2010. The date of the photo is in the lower right hand corner.
5. Percent bare ground is the only reported measure of fuel continuity.
6. Dominant graminoids: ACHY, ACNE10, ACTH7, BRTE, HECO26, POSE, and PSSPS
7. BRTE is the only annual grass reported.
8. Shrub loadings are restricted by height, long diameter, perpendicular diameter and volume. Refer to Appendix V, 'Western Juniper', for sample ranges used in this study and R² values.
9. Minimum values presented with an asterisk (*) indicate minimum value when present. Mean value includes all subplots.
10. The designation of "NA" indicates data were not available.
11. Tables of species codes and metric conversions can be found in Appendix I and II.

Western Juniper: Phase 1, Control

Site: Walker Butte Elevation: 4616 ft (1407 m)

Trees: 4% Shrubs: 2% Perennial Grass: 27% Total Grass: 27% Bare Ground: 40%



Site: Devine Ridge Elevation: 4980 ft (1518 m)

Trees: 11% Shrubs: 8% Perennial Grass: 15% Total Grass: 15% Bare Ground: 39%



Western Juniper: Phase 1, Fire

Site: Blue Mountain **Elevation:** 4918 ft (1499 m) **Treatment Date:** 09/2007
Trees: 0% Shrubs: 3% Perennial Grass: 42% Total Grass: 52% Bare Ground: 14%



07/01/09

Site: Devine Ridge **Elevation:** 4967 ft (1514 m) **Treatment Date:** 09/2007
Trees: 4% Shrubs: 2% Perennial Grass: 12% Total Grass: 24% Bare Ground: 34%



07/07/09

Western Juniper: Phase 1, Mechanical (Cutting)

Site: Bridge Creek **Elevation:** 2835 ft (864 m) **Treatment Date:** 10/2006
Trees: 0% Shrubs: 4% Perennial Grass: 34% Total Grass: 37% Bare Ground: 10%



Site: Walker Butte **Elevation:** 4656 ft (1419 m) **Treatment Date:** 10/2006
Trees: 0% Shrubs: 10% Perennial Grass: 29% Total Grass: 31% Bare Ground: 34%



Western Juniper: Phase 1

TREES

| | Treatment | JUOC | | | CELE3 | | |
|---------------------------------------|-----------|------|-----|------|-------|-----|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Total cover (%) | CO | 2 | 32 | 9 | 23* | 204 | 47 |
| | FI | <1* | 10 | 1 | 23* | 68 | 2 |
| | ME | <1* | 2 | <1 | 23* | 409 | 48 |
| Density: <1.6 ft tall (stem/ac) | CO | <1 | 13 | <1 | 23* | 68 | 3 |
| | FI | 0 | | | 0 | | |
| | ME | 0 | | | 23* | 23 | 1 |

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total loading (ton/ac) | | | Bulk density (lbs/ft³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|------|------------------------|------|-------|------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARAR8 | CO | <1* | 8 | 1 | 7 | 24 | 12 | 23* | 2,453 | 111 | NA | | | NA | | |
| | FI | 0 | | | 0 | | | 0 | | | | | | | | |
| | ME | <1* | 5 | <1 | 7 | 25 | 13 | 45* | 45 | 2 | | | | | | |
| ARTRV | CO | <1 | 12 | 2 | 2 | 54 | 13 | 114* | 2,112 | 506 | 0.02 | 1.24 | 0.36 | 0.0001 | 0.0199 | 0.0035 |
| | FI | <1* | 5 | <1 | 7 | 50 | 23 | 23* | 363 | 50 | 0.01* | 0.42 | 0.11 | 0.0001* | 0.0067 | 0.0006 |
| | ME | <1* | 24 | 7 | 6 | 59 | 22 | 136* | 2,725 | 894 | 0.02* | 5.40 | 1.18 | 0.0008* | 0.0602 | 0.0120 |
| CHVI8 | CO | <1* | 4 | 1 | 6 | 31 | 11 | 114* | 909 | 84 | <0.01* | 0.04 | <0.01 | 0.0001* | 0.0078 | 0.0009 |
| | FI | 1* | 8 | 1 | 6 | 25 | 14 | 182* | 1,295 | 83 | 0.01* | 0.17 | 0.02 | 0.0003* | 0.0054 | 0.0009 |
| | ME | <1* | 6 | 1 | 4 | 41 | 12 | 136* | 1,499 | 140 | <0.01* | 0.02 | <0.01 | 0.0002* | 0.0164 | 0.0023 |
| PUTR2 | CO | 1* | 10 | 2 | 7 | 83 | 32 | 23* | 999 | 191 | 0.21* | 0.98 | 0.13 | 0.0008* | 0.0108 | 0.0010 |
| | FI | <1* | 2 | <1 | 6 | 42 | 16 | 23* | 318 | 30 | 0.01* | 0.33 | 0.04 | 0.0002* | 0.0069 | 0.0004 |
| | ME | <1* | 12 | 2 | 5 | 93 | 38 | 23* | 522 | 94 | 0.02* | 2.70 | 0.49 | 0.0041* | 0.0237 | 0.0016 |

Western Juniper: Phase 1

NONWOODY FUELS

| | CO | | | FI | | | ME | | |
|--|---------|----------|--------|--------|----------|--------|--------|----------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 14 | 45 | 26 | 10 | 42 | 23 | 16 | 53 | 33 |
| Total cover: Annual grass [†] (%) | 1* | 15 | 1 | 1* | 18 | 5 | 1* | 5 | 1 |
| Total cover: Forbs (%) | 1 | 16 | 5 | 3 | 45 | 20 | 2 | 24 | 9 |
| Grass height (in.) | 5 | 19 | 11 | 5 | 18 | 9 | 5 | 19 | 10 |
| Forb height (in.) | 2* | 8 | 5 | 1 | 20 | 8 | 2 | 11 | 5 |
| Live loading (lbs/ac) | 95.80* | 835.35 | 314.77 | 346.50 | 1,890.96 | 785.27 | 121.77 | 773.58 | 422.33 |
| Dead loading (lbs/ac) | 40.29* | 468.26 | 178.10 | 9.85 | 332.17 | 82.19 | 9.85 | 296.36 | 110.40 |
| Total loading (lbs/ac) | 136.09 | 1,303.61 | 492.87 | 356.35 | 2,223.13 | 867.46 | 131.62 | 1,069.94 | 532.73 |
| Bulk density (lbs/ft ³) | 0.0079* | 0.0384 | 0.0205 | 0.0119 | 0.1572 | 0.0339 | 0.0103 | 0.0357 | 0.0226 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | |
|-----------------------------|------------------|------|-------|------|------|------|------|------|------|
| | CO | | | FI | | | ME | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.08 | 0.52 | 0.31 | 0.02 | 0.36 | 0.14 | 0.07 | 0.91 | 0.40 |
| 1.1–3.0 (100-hour) | 0.05 | 1.23 | 0.44 | 0.05 | 1.82 | 0.40 | 0.05 | 1.82 | 0.79 |
| 3.1–9.0 (1000-hour: Sound) | 0.12* | 1.54 | 0.13 | 0.12 | 1.39 | 0.15 | 0.12 | 4.36 | 1.20 |
| 3.1–9.0 (1000-hour: Rotten) | 0.09* | 0.09 | <0.01 | 0 | | | 0 | | |
| Total loading | 0.34 | 3.38 | 0.89 | 0.19 | 3.57 | 0.69 | 0.24 | 7.09 | 2.39 |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Depth (in.) | | | Loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|-------------------|-----------|-----------------|-----|------|-------------|-----|------|------------------|------|------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Tree litter | CO | NA | | | 0.2 | 1.5 | 0.6 | 0.06 | 2.23 | 0.53 | 0.0250 | 1.3048 | 0.5131 |
| | FI | | | | <0.1 | 0.5 | 0.1 | <0.01* | 0.34 | 0.08 | 0.0437* | 0.6805 | 0.2711 |
| | ME | | | | 0.1 | 1.0 | 0.5 | 0.01 | 1.36 | 0.43 | 0.1498 | 1.4796 | 0.5215 |
| Tree duff | CO | NA | | | 0.1 | 2.8 | 1.1 | 0.06 | 3.85 | 1.33 | 0.0437 | 2.5659 | 0.7906 |
| | FI | | | | 0.1 | 1.3 | 0.1 | 0.04 | 2.76 | 0.62 | 0.0312 | 1.5545 | 0.6389 |
| | ME | | | | 0.5 | 3.2 | 1.3 | 0.22 | 4.23 | 1.50 | 0.1498 | 1.4796 | 0.5806 |
| Interspace litter | CO | 7 | 30 | 16 | NA | | | 0.01 | 0.59 | 0.24 | NA | | |
| | FI | 5 | 32 | 17 | | | | 0.01 | 0.39 | 0.12 | | | |
| | ME | 5 | 31 | 16 | | | | <0.01 | 0.66 | 0.22 | | | |
| Bare ground | CO | 5 | 56 | 26 | NA | | | NA | | | NA | | |
| | FI | 5 | 56 | 34 | | | | | | | | | |
| | ME | 5 | 42 | 22 | | | | | | | | | |

Western Juniper: Phase 2, Control

Site: Walker Butte **Elevation:** 4616 ft (1407 m)

Trees: 7% Shrubs: 3% Perennial Grass: 14% Total Grass: 14% Bare Ground: 45%



Site: Bridge Creek **Elevation:** 2858 ft (871 m)

Trees: 25% Shrubs: 1% Perennial Grass: 30% Total Grass: 31% Bare Ground: 11%



Western Juniper: Phase 2, Fire

Site: Bridge Creek **Elevation:** 2943 ft (897 m) **Treatment Date:** 10/2006
Trees: 0% Shrubs: 2% Perennial Grass: 11% Total Grass: 39% Bare Ground: 25%



06/07/08

Site: Devine Ridge **Elevation:** 4967 ft (1514 m) **Treatment Date:** 09/2007
Trees: 8% Shrubs: 2% Perennial Grass: 12% Total Grass: 21% Bare Ground: 40%



07/29/09

Western Juniper: Phase 2, Mechanical (Cutting)

Site: Bridge Creek; **Elevation:** 2838 ft (865 m); **Treatment Date:** 10/2006
Trees: 0% Shrubs: 1% Perennial Grass: 33% Total Grass: 36% Bare Ground: 13%



Site: Blue Mountain; **Elevation:** 5108 ft (1557 m); **Treatment Date:** 10/2007
Trees: 0% Shrubs: 15% Perennial Grass: 28% Total Grass: 31% Bare Ground: 29%



Western Juniper: Phase 2

TREES

| | Treatment | JUOC | | | CELE3 | | |
|---------------------------------------|-----------|------|-----|------|-------|-----|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Total cover (%) | CO | 6 | 41 | 22 | 23* | 568 | 77 |
| | FI | 1* | 8 | 1 | 23* | 23 | 1 |
| | ME | <1* | 1 | <1 | 23* | 545 | 94 |
| Density: <1.6 ft tall (stem/ac) | CO | 1* | 11 | <1 | 23* | 23 | 1 |
| | FI | 0 | | | 0 | | |
| | ME | 3* | 15 | 1 | 23* | 91 | 11 |

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total loading (ton/ac) | | | Bulk density (lbs/ft³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-------|------|------------------------|------|-------|------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARAR8 | CO | <1* | 1 | <1 | 6 | 14 | 9 | 88* | 204 | 11 | NA | | | NA | | |
| | FI | 0 | | | 0 | | | 0 | | | | | | | | |
| | ME | 1* | 1 | <1 | 8 | 91 | 32 | 23* | 23 | 1 | | | | | | |
| ARTRV | CO | <1* | 10 | 3 | 6 | 49 | 24 | 45* | 1,317 | 496 | 0.08* | 1.27 | 0.32 | 0.0001* | 0.0135 | 0.0034 |
| | FI | 1* | 2 | <1 | 6 | 16 | 9 | 45* | 500 | 79 | <0.01* | 0.24 | 0.12 | 0.0006* | 0.0052 | 0.0009 |
| | ME | 1* | 15 | 5 | 8 | 91 | 37 | 159* | 2,453 | 878 | 0.02* | 2.97 | 0.63 | 0.0006* | 0.0315 | 0.0075 |
| CHVI8 | CO | <1* | 2 | <1 | 3 | 26 | 11 | 23 | 1,136 | 328 | <0.01* | 0.04 | <0.01 | <0.0001* | 0.0050 | 0.0003 |
| | FI | <1* | 6 | 1 | 3 | 23 | 11 | 23* | 224 | 50 | 0.01* | 0.15 | 0.08 | <0.0001* | 0.0052 | 0.0009 |
| | ME | <1* | 4 | <1 | 6 | 82 | 23 | 23* | 1,067 | 321 | <0.01* | 0.03 | <0.01 | 0.0001* | 0.0127 | 0.0007 |
| PUTR2 | CO | 1* | 14 | 4 | 1 | 47 | 17 | 0 | | | 0.06* | 2.08 | 0.42 | 0.0007* | 0.0215 | 0.0030 |
| | FI | <1* | 1 | <1 | 8 | 91 | 26 | | | | 0.02* | 0.06 | 0.01 | 0.0004* | 0.0019 | 0.0002 |
| | ME | <1* | 17 | 5 | 6 | 94 | 34 | | | | 0.26* | 1.83 | 0.44 | 0.0035* | 0.0193 | 0.0029 |

Western Juniper: Phase 2

NONWOODY FUELS

| | CO | | | FI | | | ME | | |
|--|--------|--------|--------|--------|----------|--------|--------|----------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 5 | 39 | 22 | 8 | 46 | 21 | 14 | 43 | 30 |
| Total cover: Annual grass [†] (%) | 1* | 2 | <1 | 4* | 28 | 7 | 1* | 10 | 2 |
| Total cover: Forbs (%) | 1 | 15 | 6 | 6 | 42 | 20 | 3 | 21 | 9 |
| Grass height (in.) | 5 | 14 | 9 | 4 | 15 | 9 | 5 | 20 | 10 |
| Forb height (in.) | 1 | 11 | 5 | 2 | 18 | 8 | 2 | 13 | 6 |
| Live loading (lbs/ac) | 47.45 | 625.84 | 201.55 | 171.91 | 1,552.52 | 713.44 | 147.73 | 923.99 | 351.99 |
| Dead loading (lbs/ac) | 14.33 | 253.38 | 90.08 | 9.85 | 131.62 | 53.67 | 17.01 | 494.23 | 94.05 |
| Total loading (lbs/ac) | 61.78 | 879.22 | 291.63 | 181.76 | 1,684.14 | 767.11 | 164.74 | 1,418.22 | 446.04 |
| Bulk density (lbs/ft ³) | 0.0038 | 0.0249 | 0.0134 | 0.0047 | 0.0794 | 0.0301 | 0.0072 | 0.0348 | 0.0175 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | |
|-----------------------------|------------------|-------|------|-------|------|------|-------|-------|-------|
| | CO | | | FI | | | ME | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.06 | 0.74 | 0.39 | 0.08 | 0.51 | 0.20 | 0.11 | 0.98 | 0.54 |
| 1.1–3.0 (100-hour) | 0.10 | 2.16 | 0.65 | 0.10 | 1.62 | 0.55 | 0.34 | 3.20 | 1.79 |
| 3.1–9.0 (1000-hour: Sound) | 0.12* | 3.52 | 0.21 | 0.19* | 4.33 | 0.88 | 0.21 | 11.14 | 3.94 |
| 3.1–9.0 (1000-hour: Rotten) | 0.11 | 5.14 | 0.19 | 0 | | | 0.07* | 0.07 | <0.01 |
| Total loading | 0.39 | 11.56 | 1.44 | 0.37 | 6.46 | 1.63 | 0.73 | 15.39 | 6.28 |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Depth (in.) | | | Loading (ton/ac) | | | Bulk density (lbs/ft ³) | | |
|-------------------|-----------|-----------------|-----|------|-------------|-----|------|------------------|------|------|-------------------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Tree litter | CO | NA | | | <1 | 1 | 1 | 0.22 | 3.38 | 1.14 | 0.3808 | 2.5871 | 1.1429 |
| | FI | | | | <1 | <1 | <1 | <0.01* | 0.38 | 0.09 | 0.0562* | 3.4087 | 0.7526 |
| | ME | | | | <1 | 1 | <1 | 0.06 | 6.56 | 1.03 | 0.2123 | 2.8905 | 1.0029 |
| Tree duff | CO | NA | | | <1 | 3 | 1 | 0.67 | 7.95 | 3.95 | 0.4058 | 5.0630 | 2.0710 |
| | FI | | | | <1 | 1 | <1 | 0.07 | 0.95 | 0.47 | 0.2997 | 4.3201 | 1.2727 |
| | ME | | | | 1 | 2 | 1 | 0.30 | 6.36 | 3.05 | 0.2872 | 4.2390 | 1.7437 |
| Interspace litter | CO | 9 | 30 | 18 | NA | | | 0.01 | 0.62 | 0.21 | NA | | |
| | FI | 7 | 24 | 14 | | | | 0.01 | 0.17 | 0.08 | | | |
| | ME | 10 | 34 | 19 | | | | 0.01 | 0.48 | 0.17 | | | |
| Bare ground | CO | 9 | 52 | 26 | NA | | | NA | | | NA | | |
| | FI | 14 | 67 | 37 | | | | | | | | | |
| | ME | 9 | 44 | 19 | | | | | | | | | |

Western Juniper: Phase 3, Control

Site: Devine Ridge Elevation: 4980 ft (1518 m)

Trees: 44% Shrubs: 3% Perennial Grass: 20% Total Grass: 20% Bare Ground: 9%



Site: Devine Ridge Elevation: 4980 ft (1518 m)

Trees: 48% Shrubs: 3% Perennial Grass: 13% Total Grass: 15% Bare Ground: 32%



Western Juniper: Phase 3, Fire

Site: Bridge Creek **Elevation:** 2943 ft (897 m) **Treatment Date:** 10/2006
Trees: 0% Shrubs: 0% Perennial Grass: 21% Total Grass: 24% Bare Ground: 38%



Site: Blue Mountain **Elevation:** 4918 ft (1499 m) **Treatment Date:** 09/2007
Trees: 7% Shrubs: 7% Perennial Grass: 20% Total Grass: 21% Bare Ground: 23%



Western Juniper: Phase 3, Mechanical (Cutting)

Site: Bridge Creek **Elevation:** 2838 ft (865 m) **Treatment Date:** 10/2006
Trees: <1% Shrubs: 2% Perennial Grass: 18% Total Grass: 18% Bare Ground: 40%



Site: Walker Butte **Elevation:** 4656 ft (1419 m) **Treatment Date:** 10/2006
Trees: 2% Shrubs: 9% Perennial Grass: 32% Total Grass: 37% Bare Ground: 21%



Western Juniper: Phase 3

TREES

| | Treatment | JUOC | | | CELE3 | | |
|---------------------------------------|-----------|------|-----|------|-------|-----|------|
| | | Min | Max | Mean | Min | Max | Mean |
| Total cover (%) | CO | 10 | 48 | 30 | 23* | 68 | 19 |
| | FI | <1* | 9 | 2 | 23* | 23 | 5 |
| | ME | <1* | 2 | 1 | 23* | 204 | 96 |
| Density: <1.6 ft tall (stem/ac) | CO | 0 | | | 0 | | |
| | FI | 0 | | | 0 | | |
| | ME | <1* | 13 | 3 | 45* | 954 | 93 |

SHRUBS

| Species | Treatment | Total cover (%) | | | Height (in.) | | | Density (#/acre) | | | Total loading (ton/ac) | | | Bulk density (lbs/ft³) | | |
|---------|-----------|-----------------|-----|------|--------------|-----|------|------------------|-----|------|------------------------|-------|-------|------------------------|--------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| ARAR8 | CO | 1* | 1 | <1 | 9 | 17 | 13 | 45* | 114 | 13 | NA | | | NA | | |
| | FI | 0 | | | 0 | | | 0 | | | | | | | | |
| | ME | 1* | 1 | <1 | 9 | 70 | 33 | | | | | | | | | |
| ARTRV | CO | 1* | 7 | 2 | 6 | 71 | 24 | 23 | 977 | 291 | 0.01* | 0.29 | 0.12 | 0.0002* | 0.0060 | 0.0021 |
| | FI | <1* | 3 | 1 | 6 | 76 | 22 | 45* | 545 | 115 | <0.01* | 0.29 | 0.14 | 0.0001* | 0.0044 | 0.0015 |
| | ME | <1* | 3 | 1 | 9 | 70 | 35 | 23* | 545 | 163 | 0.02* | 0.08 | 0.04 | 0.0003* | 0.0019 | 0.0006 |
| CHVI8 | CO | <1* | <1 | <1 | 6 | 76 | 17 | 45* | 500 | 138 | NA | | | NA | | |
| | FI | <1* | 2 | <1 | 6 | 70 | 21 | 23* | 658 | 87 | <0.01* | 0.02 | <0.01 | 0.0001* | 0.0044 | 0.0015 |
| | ME | <1* | 6 | 1 | 6 | 70 | 21 | 23* | 817 | 161 | <0.01* | <0.01 | <0.01 | <0.0001* | 0.0008 | 0.0001 |
| PUTR2 | CO | 1* | 7 | 2 | 6 | 76 | 18 | 0 | | | 0.23* | 0.79 | 0.25 | 0.0032* | 0.0085 | 0.0014 |
| | FI | <1* | 6 | 1 | 6 | 70 | 25 | | | | 0.02* | 0.97 | 0.27 | 0.0002* | 0.0162 | 0.0032 |
| | ME | <1* | 14 | 3 | 6 | 70 | 23 | | | | 0.39* | 2.31 | 0.48 | 0.0045* | 0.0230 | 0.0029 |

Western Juniper: Phase 3

NONWOODY FUELS

| | CO | | | FI | | | ME | | |
|--|--------|--------|--------|--------|----------|--------|--------|--------|--------|
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Total cover: Perennial grass [†] (%) | 12 | 38 | 18 | 4 | 33 | 16 | 16 | 55 | 28 |
| Total cover: Annual grass [†] (%) | 1* | 2 | 1 | 1 | 20 | 6 | 1* | 15 | 5 |
| Total cover: Forbs (%) | 1* | 18 | 4 | 3 | 44 | 21 | 3 | 17 | 11 |
| Grass height (in.) | 5 | 11 | 7 | 6 | 14 | 9 | 4 | 15 | 9 |
| Forb height (in.) | 1 | 11 | 4 | 3 | 15 | 8 | 2 | 11 | 6 |
| Live loading (lbs/ac) | 20.14 | 188.92 | 102.44 | 214.88 | 819.24 | 484.17 | 138.78 | 530.04 | 284.72 |
| Dead loading (lbs/ac) | 14.33 | 229.21 | 76.63 | 4.48 | 217.57 | 62.95 | 7.16 | 207.72 | 47.38 |
| Total loading (lbs/ac) | 34.47 | 418.13 | 179.07 | 219.36 | 1,036.81 | 547.12 | 145.94 | 737.76 | 332.10 |
| Bulk density (lbs/ft ³) | 0.0049 | 0.0279 | 0.0112 | 0.0091 | 0.0255 | 0.0190 | 0.0095 | 0.0231 | 0.0144 |

[†]Species used to calculate perennial grass cover were all native, and cheatgrass was the only annual grass.

WOODY FUELS

| Diameter (in.) | Loading (ton/ac) | | | | | | | | |
|-----------------------------|------------------|------|------|-------|-------|------|------|-------|-------|
| | CO | | | FI | | | ME | | |
| | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| 0.26–1.0 (10-hour) | 0.16 | 0.60 | 0.37 | 0.04 | 0.59 | 0.26 | 0.12 | 2.48 | 0.92 |
| 1.1–3.0 (100-hour) | 0.10* | 0.84 | 0.43 | 0.05* | 3.69 | 0.75 | 0.89 | 5.95 | 2.71 |
| 3.1–9.0 (1000-hour: Sound) | 0.18* | 1.97 | 0.40 | 0.21* | 9.45 | 2.00 | 1.97 | 10.91 | 7.18 |
| 3.1–9.0 (1000-hour: Rotten) | 0.93* | 0.93 | 0.08 | 0 | | | 0 | | |
| Total loading | 1.37 | 4.34 | 1.28 | 0.3 | 13.73 | 3.01 | 2.98 | 19.34 | 10.81 |

LITTER and DUFF

| | Treatment | Total cover (%) | | | Depth (in.) | | | Loading (ton/ac) | | | Bulk density (lbs/ft³) | | |
|-------------------|-----------|-----------------|-----|------|-------------|-----|------|------------------|-------|------|------------------------|---------|--------|
| | | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Mean |
| Tree litter | CO | NA | | | 1 | 1 | <1 | 0.35 | 2.16 | 1.06 | 0.7055 | 3.7707 | 1.4619 |
| | FI | | | | 1 | 1 | <1 | 0.03 | 3.04 | 0.86 | 0.2247 | 4.8196 | 1.6345 |
| | ME | | | | 1 | 1 | <1 | 0.19 | 4.02 | 1.73 | 0.8990 | 3.9393 | 2.1538 |
| Tree duff | CO | NA | | | 1 | 2 | 1 | 3.50 | 9.59 | 5.99 | 1.5920 | 5.3689 | 3.1558 |
| | FI | | | | 1 | 1 | <1 | 0.03 | 7.91 | 1.76 | 0.4245 | 11.4808 | 2.9700 |
| | ME | | | | 1 | 2 | 1 | 1.97 | 13.15 | 6.28 | 2.2724 | 5.3252 | 3.4071 |
| Interspace litter | CO | 10 | 42 | 24 | NA | | | 0.03 | 1.20 | 0.28 | NA | | |
| | FI | 4 | 39 | 22 | | | | 0.02 | 0.52 | 0.19 | | | |
| | ME | 9 | 31 | 22 | | | | <0.01 | 0.73 | 0.17 | | | |
| Bare ground | CO | 9 | 49 | 25 | NA | | | NA | | | NA | | |
| | FI | 9 | 65 | 32 | | | | | | | | | |
| | ME | 3 | 40 | 15 | | | | | | | | | |

Appendix I: Species Index

| Stratum | Code* | Scientific Name | Common Name |
|-------------------|--|--|-----------------------------|
| Trees | CELE3 | <i>Cercocarpus ledifolius</i> | curl-leaf mountain mahogany |
| | JUOC | <i>Juniperus occidentalis</i> | western juniper |
| | JUOS | <i>Juniperus osteosperma</i> | little Utah juniper |
| | PIED | <i>Pinus edulis</i> | twoneedle pinyon pine |
| | PIMO | <i>Pinus monophylla</i> | singleleaf pinyon pine |
| Shrubs | ARAR8 | <i>Artemisia arbuscula</i> | little sagebrush |
| | ARNO4 | <i>Artemisia nova</i> | black sagebrush |
| | ARTRV | <i>Artemisia tridentata (vaseyana)</i> | mountain big sagebrush |
| | ARTRW8 | <i>Artemisia tridentata (wyomingensis)</i> | Wyoming big sagebrush |
| | CHVI8 | <i>Chrysothamnus viscidiflorus</i> | yellow rabbitbrush |
| | PUTR2 | <i>Purshia tridentata</i> | antelope bitterbrush |
| Graminoids | ACHY | <i>Achnatherum hymenoides</i> | Indian ricegrass |
| | ACNE10 | <i>Achnatherum nevadense</i> | Nevada needlegrass |
| | ACTH7 | <i>Achnatherum thurberianum</i> | Thurber's needlegrass |
| | BRAR5 | <i>Bromus arvensis</i> | field brome |
| | BRTE | <i>Bromus tectorum</i> | cheatgrass |
| | ELEL5 | <i>Elymus elymoides</i> | squirreltail |
| | FEID | <i>Festuca idahoensis</i> | Idaho fescue |
| | HECO26 | <i>Hesperostipa comata</i> | needle and thread |
| | LECI4 | <i>Leymus cinereus</i> | basin wildrye |
| | PASM | <i>Pascopyrum smithii</i> | western wheatgrass |
| | PLJA | <i>Pleuraphis jamesii</i> | James' galleta |
| | POCU3 | <i>Poa cusickii</i> | Cusick's bluegrass |
| | POSE | <i>Poa secunda</i> | Sandberg bluegrass |
| PSSPS | <i>Pseudoroegneria spicata spicata</i> | bluebunch wheatgrass | |

*USDA NRCS 2011

Appendix II: Conversion Table

| Reported Unit | Conversions |
|----------------------|--|
| 1 ac | 0.4050 ha; 4046.8560 m ² |
| 1 in. | 2.5400 cm |
| 1 ft | 0.3048 m |
| 1 lb | 0.0005 ton; 0.4520 kg |
| 1 ton | 907.2000 kg |
| 1 lb/ac | 0.0005 ton/ac; 0.0001 kg/m ² ; 1.1200 kg/ha |
| 1 ton/ac | 0.2242 kg/m ² ; 2241.7023 kg/ha |
| 1 lb/ft ³ | 16.0000 kg/m ³ |

Appendix III: Glossary of Terms

Available fuel loading: Fuel that could be readily consumed at any given time. Highly dependent of fuel moisture, particle size and arrangement (Miller 2001).

Biomass: All vegetation on the site (Miller 2001).

Bulk density: Weight of biomass per unit volume; loading/fuel depth (Brown 1982).

Common species: Species that have the highest abundance on the site.

Community: An assemblage of plants, animals, bacteria and fungi that live in an environment, interact with one another, forming a distinctive living system within its own composition, structure, environmental relations, development and function (Whittaker 1975). It is the biotic component of the ecosystem and has no implicit definition of spatial extent or boundaries (Kimmins 1987).

Dominant species: Species that exerts ecological influence over other species on the site.

Duff: The fermentation and humus layers of the forest floor. Needles, leaves, and other castoff vegetation are no longer distinguishable due to decomposition (Brown 1974).

Ecosystem: The community and non-living environment functioning together as an ecological system (Odum 1971). No implicit definition of spatial extent or boundaries (Kimmins 1987).

Fire behavior model: A computer model that uses a set of physically based mathematical equations to predict certain aspects of fire behavior. Inputs include fuel characteristics and environmental conditions for a particular site (Rothermel 1972).

Fire regime: A general description of the role fire plays in an ecosystem. It can be described by characteristics of the disturbance (type, frequency, predictability, extent, magnitude, synergism or timing), a summary of the ecological effects on the dominant or potential vegetation of the ecosystems, or the fire severity on dominant vegetation (Agee 1993).

Fire return interval: The number of years between two successive fire events at a specific site or an area of a specified size (Agee 1993).

Fuel: Live and dead biomass that contribute to wildland fire (Davis 1959). Often defined by loading, depth, height, and bulk density.

Fuelbed: Measured or averaged physical characteristics of reactively uniform unit on the landscape that represents a distinct fire environment (Riccardi et al. 2001).

Fuelbed depth: Depth of surface fuel available to the flaming front (Miller 2001).

Fuel continuity: Relates to the proximity of individual fuel particles as well as different fuel strata. It affects fire spread, ignition rates and area and how much consumption takes place (Miller 2001).

Fuel loading: Weight of fuel per unit area (Brown 1982).

Fuel strata: A horizontal layer of fuel having approximately the same composition throughout; parallel layers arranged one on top of another. Identified in this Guide as trees, shrubs, nonwoody fuel, woody fuels, litter and duff (Ottmar et al. 2007, Sandberg et al. 2001).

Litter: The surface layer of the site consisting of freshly fallen leaves, needles, twigs, bark and fruits (Brown 1974).

Time lag: The length of time it takes a fuel particle to reach 63 percent equilibrium moisture content with the environment at standard conditions of 80° F and 20 percent relative humidity (Schroeder and Buck 1970).

1-hour fuel: Fuel particles with 0–0.24 in. (0–0.6 cm) diameter; fuel size class distinction (Brown 1974). One-hour refers to the timelag.

10-hour fuel: Fuel particles with 0.25–0.99 in. (0.6–2.5 cm) diameter; fuel size class distinction (Brown 1974). Ten-hour refers to the timelag.

100-hour fuel: Fuel particles with 1.00–2.99 in. (2.5–7.6 cm) diameter; fuel size class distinction (Brown 1974). Hundred-hour refers to the timelag.

1000-hour fuel: Fuel particles with greater than 3.00 in. (7.6 cm) diameter; fuel size class distinction (Brown 1974). Thousand-hour refers to the timelag.

Appendix IV: Shrub Loadings by Size Class

Size class loadings were calculated from site- and species-specific linear regressions developed from harvest sampling (Pechanec and Pickford 1937, Riser 1984). Various combinations of shrub height, longest diameter, perpendicular diameter and volume were used as predictor variables in the regressions. One-hour loading includes foliage and 1-hour fuels from the shrub canopy. The available loading assumes 100% of the 1-hour and 50% of the 10-hour fuels will consume in the flaming front*.

*Wright, C.S. 2008. Personal Communication. Research Forester, USDA Forest Service, Pacific Northwest Research Station, Pacific Wildland Fire Sciences Laboratory, Seattle, WA.

LIVE LOADING AT SAGEBRUSH STEPPE SITES

| Live Loading | | Group 1 | | | | | | | | Group 2 | | | | | | | |
|-----------------------|------|---------|--------|-------|-------|--------|-------|-------|-------|---------|--------|--------|------|-------|--------|--------|----|
| | | ARTRW8 | | | | CHVI8 | | | | ARTRW8 | | | | CHVI8 | | | |
| | | CO | FI | MO | TE | CO | FI | MO | TE | CO | FI | MO | TE | CO | FI | MO | TE |
| 1-hour (ton/ac) | Min | 0.37 | 0.03* | 0.04* | 0.24 | <0.01* | 0.04* | 0.01* | 0.02* | 0.29 | <0.01* | 0.02* | 0.19 | 0.01* | <0.01* | 0.01* | NA |
| | Max | 3.11 | 2.47 | 0.77 | 4.60 | 1.17 | 0.08 | 0.36 | 1.79 | 2.58 | 1.86 | 1.81 | 1.81 | 0.01 | 0.03 | 0.09 | |
| | Mean | 1.08 | 0.78 | 0.30 | 1.28 | 0.19 | 0.01 | 0.03 | 0.16 | 0.91 | 0.34 | 0.38 | 0.63 | <0.01 | <0.01 | 0.01 | |
| 10-hour (ton/ac) | Min | 0.39 | 0.02 | 0.05 | 0.19 | 0.01* | 0.01* | 0 | 0 | 0.20* | <0.01* | 0.01* | 0.16 | 0 | 0.01* | NA | |
| | Max | 1.72 | 1.61 | 0.54 | 2.57 | 0.01 | 0.01 | | | 1.71 | 1.45 | 1.15 | 2.22 | | 0.02 | | |
| | Mean | 0.79 | 0.49 | 0.25 | 0.76 | <0.01 | <0.01 | | | 0.60 | 0.25 | 0.25 | 0.71 | | <0.01 | | |
| Available (ton/ac) | Min | 0.60 | 0.04 | 0.08* | 0.33 | <0.01* | 0.04 | 0.01* | 0.02* | 0.43* | 0.01* | 0.02* | 0.53 | 0.01* | <0.01* | 0.01 | NA |
| | Max | 3.96 | 3.27 | 1.04 | 5.21 | 1.17 | 0.08 | 0.36 | 1.79 | 2.95 | 2.58 | 2.32 | 2.93 | 0.01 | 0.03 | 0.10 | |
| | Mean | 1.47 | 1.03 | 0.42 | 1.85 | 0.19 | 0.01 | 0.03 | 0.16 | 1.21 | 0.46 | 0.50 | 1.11 | <0.01 | <0.01 | 0.01 | |
| | | Group 3 | | | | | | | | Group 4 | | | | | | | |
| 1-hour (ton/ac) | Min | 0.47 | <0.01* | 0.44 | 0.72* | 0.07* | NA | NA | NA | 0.18 | <0.01* | 0.01* | 0.03 | NA | 0.05* | <0.01* | NA |
| | Max | 11.10 | 12.72 | 1.30 | 7.20 | 0.07 | | | | 3.38 | 1.70 | 1.75 | 6.32 | | 0.05 | <0.01 | |
| | Mean | 4.82 | 1.76 | 0.92 | 2.87 | 0.01 | | | | 1.18 | 0.22 | 0.34 | 1.39 | | <0.01 | <0.01 | |
| 10-hour (ton/ac) | Min | 0.04 | <0.01* | 0.02* | 0.35* | <0.01* | NA | NA | NA | 0.17 | <0.01* | <0.01* | 0.03 | NA | 0 | NA | |
| | Max | 1.23 | 0.94 | 0.74 | 1.49 | <0.01 | | | | 4.29 | 0.76 | 0.97 | 3.33 | | | | |
| | Mean | 0.70 | 0.18 | 0.27 | 0.87 | <0.01 | | | | 1.26 | 0.12 | 0.42 | 1.05 | | | | |
| Available (ton/ac) | Min | 0.75 | <0.01* | 0.67 | 1.20* | 0.07* | NA | NA | NA | 0.27 | <0.01* | 0.01* | 0.80 | NA | 0.05* | <0.01* | NA |
| | Max | 11.54 | 13.19 | 1.30 | 7.87 | 0.07 | | | | 5.52 | 1.80 | 2.23 | 7.98 | | 0.05 | <0.01 | |
| | Mean | 5.17 | 1.85 | 1.06 | 3.36 | 0.01 | | | | 1.81 | 0.28 | 0.75 | 2.32 | | <0.01 | <0.01 | |

DEAD LOADING AT SAGEBRUSH STEPPE SITES

| Dead Loading | | Group 1 | | | | | | | | Group 2 | | | | | | | |
|-----------------------|------|---------|----|----|----|-------|----|----|----|---------|----|----|----|-------|----|----|----|
| | | ARTRW8 | | | | CHVI8 | | | | ARTRW8 | | | | CHVI8 | | | |
| | | CO | FI | MO | TE | CO | FI | MO | TE | CO | FI | MO | TE | CO | FI | MO | TE |
| 1-hour (ton/ac) | Min | | | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | | |
| | Mean | | | | | | | | | | | | | | | | |
| 10-hour (ton/ac) | Min | NA | | | | NA | | | | NA | | | | NA | | | |
| | Max | NA | | | | NA | | | | NA | | | | NA | | | |
| | Mean | NA | | | | NA | | | | NA | | | | NA | | | |
| Available (ton/ac) | Min | NA | | | | NA | | | | NA | | | | NA | | | |
| | Max | NA | | | | NA | | | | NA | | | | NA | | | |
| | Mean | NA | | | | NA | | | | NA | | | | NA | | | |
| | | Group 3 | | | | | | | | Group 4 | | | | | | | |
| 1-hour (ton/ac) | Min | | | | | | | | | | | | | | | | |
| | Max | | | | | | | | | | | | | | | | |
| | Mean | | | | | | | | | | | | | | | | |
| 10-hour (ton/ac) | Min | NA | | | | NA | | | | NA | | | | NA | | | |
| | Max | NA | | | | NA | | | | NA | | | | NA | | | |
| | Mean | NA | | | | NA | | | | NA | | | | NA | | | |
| Available (ton/ac) | Min | NA | | | | NA | | | | NA | | | | NA | | | |
| | Max | NA | | | | NA | | | | NA | | | | NA | | | |
| | Mean | NA | | | | NA | | | | NA | | | | NA | | | |

LIVE LOADING AT PINYON-JUNIPER SITES

| Phase | Live Loading | | ARAR8 | | | ARNO4 | | | ARTRW8 | | | CHVI8 | | | PUTR2 | | | | |
|-------|-----------------------|------|-------|----|-------|-------|--------|-------|--------|-------|-------|--------|-------|--------|-------|-------|-------|------|------|
| | | | CO | FI | ME | CO | FI | ME | CO | FI | ME | CO | FI | ME | CO | FI | ME | | |
| 1 | 1-hour (ton/ac) | Min | 0 | | | 0 | <0.01* | 0.06* | 0.09 | 0.09 | <0.01 | 0.05* | 0.05 | <0.01* | 0.06 | 0.06 | <0.01 | | |
| | | Max | 0 | | | | 0 | 0.17 | 0.06 | 1.01 | 1.01 | 0.89 | 1.15 | 1.15 | 0.07 | 0.43 | 0.43 | 0.04 | |
| | | Mean | 0 | | | | 0 | 0.04 | 0.01 | 0.64 | 0.64 | 0.16 | 0.18 | 0.18 | 0.02 | 0.21 | 0.21 | 0.01 | |
| | 10-hour (ton/ac) | Min | 0 | | | 0 | <0.01 | 0.06* | 0.06 | 0.06 | <0.01 | 0.02* | 0.02 | <0.01* | 0.05 | 0.05 | <0.01 | | |
| | | Max | 0 | | | | 0 | 0.14 | 0.06 | 1.05 | 1.05 | 0.91 | 0.04 | 0.04 | 0.01 | 0.52 | 0.52 | 0.04 | |
| | | Mean | 0 | | | | 0 | 0.04 | 0.01 | 0.45 | 0.45 | 0.14 | 0.01 | 0.01 | <0.01 | 0.24 | 0.24 | 0.01 | |
| | Available (ton/ac) | Min | 0 | | | 0 | <0.01* | 0.09* | 0.12 | 0.12 | <0.01 | 0.05* | 0.05 | <0.01* | 0.08 | 0.08 | <0.01 | | |
| | | Max | 0 | | | | 0 | 0.24 | 0.09 | 1.53 | 1.53 | 1.35 | 1.15 | 1.15 | 0.07 | 0.69 | 0.69 | 0.05 | |
| | | Mean | 0 | | | | 0 | 0.06 | 0.02 | 0.86 | 0.86 | 0.23 | 0.18 | 0.18 | 0.02 | 0.33 | 0.33 | 0.02 | |
| 2 | 1-hour (ton/ac) | Min | 0.01 | 0 | 0.27* | 0 | <0.01* | 0 | 0.01 | <0.01 | 0.20 | <0.01* | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 | | |
| | | Max | 0.24 | | 0.28 | | 0 | | 0.37 | 0.47 | 0.72 | 1.47 | 0.12 | 0.04 | 0.07 | 0.46 | 0.09 | 0.06 | |
| | | Mean | 0.13 | | 0.27 | | 0 | | 0.05 | 0.25 | 0.09 | 0.65 | 0.02 | 0.01 | 0.02 | 0.13 | 0.03 | 0.03 | |
| | 10-hour (ton/ac) | Min | 0.01 | 0 | 0.19* | 0 | <0.01* | 0 | 0.01 | <0.01 | 0.10 | <0.01* | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 | | |
| | | Max | 0.16 | | 0.19 | | 0 | | 0.41 | 0.48 | 0.80 | 1.09 | 0.06 | 0.01 | 0.04 | 0.53 | 0.09 | 0.06 | |
| | | Mean | 0.10 | | 0.19 | | 0 | | 0.05 | 1.18 | 0.80 | 0.48 | 0.01 | <0.01 | 0.01 | 0.14 | 0.03 | 0.02 | |
| | Available (ton/ac) | Min | 0.20 | 0 | 0.36* | 0 | <0.01* | 0 | 0.01 | <0.01 | 0.25 | <0.01* | <0.01 | <0.01 | 0.03 | <0.01 | <0.01 | | |
| | | Max | 0.32 | | 0.37 | | 0 | | 0.57 | 0.66 | 1.11 | 1.86 | 0.12 | 0.04 | 0.13 | 0.73 | 0.14 | 0.09 | |
| | | Mean | 0.18 | | 0.37 | | 0 | | 0.08 | 0.35 | 0.13 | 0.89 | 0.02 | 0.01 | 0.02 | 0.20 | 0.04 | 0.04 | |
| 3 | 1-hour (ton/ac) | Min | 0 | | | 0 | 0.05* | 0 | 0.01 | <0.01 | 0.06 | <0.01 | 0 | 0.02 | <0.01 | 0.01 | | | |
| | | Max | 0 | | | | 0 | | 0.10 | 0.05 | 0 | 0.22 | | 0.06 | 0.81 | 0.01 | 0.15 | 0.09 | 0.01 |
| | | Mean | 0 | | | | 0 | | 0.04 | 0.05 | 0 | 0.08 | | 0.05 | 0.26 | <0.01 | 0.06 | 0.03 | 0.01 |
| | 10-hour (ton/ac) | Min | 0 | | | 0 | 0.05* | 0 | <0.01 | <0.01 | 0.01 | <0.01 | 0 | 0.01 | 0.01 | 0.01 | | | |
| | | Max | 0 | | | | 0 | | 0.04 | 0.05 | 0 | 0.17 | | 0.07 | 0.82 | 0.02 | 0.12 | 0.07 | 0.01 |
| | | Mean | 0 | | | | 0 | | 0.02 | 0.03 | 0 | 0.04 | | 0.02 | 0.20 | <0.01 | 0.05 | 0.03 | 0.01 |
| | Available (ton/ac) | Min | 0 | | | 0 | 0.08* | 0 | 0.01 | <0.01 | 0.06 | <0.01 | 0 | 0.03 | <0.01 | 0.01 | | | |
| | | Max | 0 | | | | 0 | | 0.12 | 0.08 | 0 | 0.29 | | 0.10 | 1.22 | 0.02 | 0.21 | 0.12 | 0.01 |
| | | Mean | 0 | | | | 0 | | 0.05 | 0.04 | 0 | 0.10 | | 0.04 | 0.36 | <0.01 | 0.09 | 0.05 | 0.01 |

LIVE LOADING AT UTAH JUNIPER SITES

| Phase | Live Loading | | ARTRV | | | | ARTRW8 | | | | CHVI8 | | | | PUTR2 | | | |
|-------|-----------------------|------|-------|------|----|-------|--------|--------|--------|-------|--------|--------|--------|--------|--------|-------|----|--------|
| | | | CO | BM | FI | ME | CO | BM | FI | ME | CO | BM | FI | ME | CO | BM | FI | ME |
| 1 | 1-hour (ton/ac) | Min | 0.58 | 0.05 | 0 | 0.68 | 0.21 | 0.06 | <0.01 | 0.20 | <0.01 | 0.02* | <0.01* | 0.09* | 0.13 | 0.36* | 0 | 0.22 |
| | | Max | 1.79 | 0.06 | | 0.68 | 1.73 | 0.79 | 0.13 | 2.06 | 0.06 | 0.21 | 0.18 | 0.38 | 0.70 | 2.31 | | 0.22 |
| | | Mean | 1.10 | 0.05 | | 0.68 | 0.77 | 0.38 | 0.02 | 0.90 | <0.01 | 0.02 | 0.03 | 0.07 | 0.34 | 1.21 | | 0.22 |
| | 10-hour (ton/ac) | Min | 0.31 | 0.06 | 0 | 0.74 | 0.27 | 0.08 | <0.01 | 0.18 | 0 | | | | 0.15 | 0.38* | 0 | 0.26 |
| | | Max | 2.02 | 0.06 | | 0.74 | 1.97 | 1.00 | 0.13 | 2.47 | | | | | 0.93 | 3.04 | | 0.26 |
| | | Mean | 1.19 | 0.06 | | 0.74 | 0.86 | 0.44 | 0.03 | 1.13 | | | | | 0.43 | 1.45 | | 0.26 |
| | Available (ton/ac) | Min | 0.73 | 0.08 | 0 | 1.05 | 0.34 | 0.11 | <0.01 | 0.09 | <0.01* | 0.02* | <0.01* | 0.09* | 0.20 | 0.55* | 0 | 0.35 |
| | | Max | 2.80 | 0.09 | | 1.05 | 2.71 | 1.29 | 0.19 | 3.22 | 0.06 | 0.21 | 0.18 | 0.38 | 1.16 | 3.83 | | 0.35 |
| | | Mean | 1.70 | 0.08 | | 1.05 | 1.20 | 0.60 | 0.04 | 1.46 | <0.01 | 0.02 | 0.03 | 0.07 | 0.56 | 1.93 | | 0.35 |
| 2 | 1-hour (ton/ac) | Min | 0.22 | 0.06 | 0 | 0.01 | 0.06 | <0.01 | <0.01 | 0.03 | <0.01* | <0.01* | <0.01* | 0.08* | 0.01* | <0.01 | 0 | 0.03 |
| | | Max | 1.64 | 0.45 | | 0.19 | 1.65 | 0.97 | 0.40 | 1.35 | 0.08 | 0.13 | 0.10 | 0.24 | 0.23 | 1.12 | | 0.34 |
| | | Mean | 0.67 | 0.21 | | 0.09 | 0.48 | 0.32 | 0.08 | 0.64 | 0.01 | 0.01 | 0.02 | 0.04 | 0.06 | 0.47 | | 0.15 |
| | 10-hour (ton/ac) | Min | 0.20 | 0.07 | 0 | 0.01 | 0.08 | 0.01 | <0.01 | 0.03 | 0 | | | | <0.01* | <0.01 | 0 | 0.03 |
| | | Max | 1.84 | 0.52 | | 0.20 | 2.14 | 1.17 | 0.39 | 1.53 | | | | | 0.28 | 1.68 | | 0.44 |
| | | Mean | 0.65 | 0.25 | | 0.10 | 0.62 | 0.42 | 0.09 | 0.73 | | | | | 0.07 | 0.68 | | 0.19 |
| | Available (ton/ac) | Min | 0.32 | 0.09 | 0 | 0.02 | 0.10 | 0.01 | <0.01 | 0.04 | <0.01* | <0.01* | 0.01* | 0.08* | <0.01 | 0.01 | 0 | 0.04 |
| | | Max | 2.55 | 0.71 | | 0.29 | 2.72 | 1.55 | 0.60 | 0.03 | 0.09 | 0.13 | 0.10 | 0.24 | 0.37 | 1.96 | | 0.56 |
| | | Mean | 1.00 | 0.33 | | 0.14 | 0.79 | 0.53 | 0.13 | 1.01 | 0.01 | 0.01 | 0.02 | 0.04 | 0.15 | 0.81 | | 0.24 |
| 3 | 1-hour (ton/ac) | Min | 0.01 | 0.05 | 0 | 0.06 | 0.02 | <0.01* | 0.01* | 0.01* | <0.01* | <0.01* | <0.01* | <0.01* | 0.02 | 0.01 | 0 | <0.01* |
| | | Max | 0.19 | 0.29 | | 0.40 | 0.86 | 0.38 | 0.12 | 0.51 | <0.01 | 0.02 | <0.01 | 0.26 | 0.02 | 0.07 | | 0.63 |
| | | Mean | 0.11 | 0.13 | | 0.20 | 0.19 | 0.08 | 0.06 | 0.09 | <0.01 | <0.01 | <0.01 | 0.02 | 0.02 | 0.04 | | 0.27 |
| | 10-hour (ton/ac) | Min | <0.01 | 0.05 | 0 | 0.09* | 0.01 | <0.01* | <0.01* | 0.01* | 0 | | | | 0.02 | 0.01 | 0 | 0.03 |
| | | Max | 0.17 | 0.33 | | 0.40 | 0.49 | 0.28 | 0.09 | 0.62 | | | | | 0.02 | 0.09 | | 0.85 |
| | | Mean | 0.10 | 0.14 | | 0.19 | 0.19 | 0.09 | 0.06 | 0.09 | | | | | 0.02 | 0.04 | | 0.35 |
| | Available (ton/ac) | Min | 0.01 | 0.07 | 0 | 0.06 | 0.03 | <0.01* | 0.01* | 0.01* | <0.01* | <0.01* | <0.01* | <0.01* | 0.03 | 0.01 | 0 | <0.01* |
| | | Max | 0.28 | 0.45 | | 0.60 | 1.05 | 0.52 | 0.17 | 0.82 | <0.01 | 0.02 | 0.01 | 0.26 | 0.03 | 0.11 | | 1.02 |
| | | Mean | 0.16 | 0.20 | | 0.30 | 0.29 | 0.14 | 0.09 | 0.15 | <0.01 | <0.01 | <0.01 | 0.02 | 0.03 | 0.06 | | 0.45 |

LIVE LOADING AT WESTERN JUNIPER SITES

| Phase | Live Loading | | ARAR8 | | | ARTRV | | | CHVI8 | | | PUTR2 | | |
|-------|-----------------------|------|-------|----|----|--------|--------|------|--------|--------|--------|-------|--------|--------|
| | | | CO | FI | ME | CO | FI | ME | CO | FI | ME | CO | FI | ME |
| 1 | 1-hour (ton/ac) | Min | NA | | | <0.01* | <0.01* | 0.01 | <0.01* | 0.01* | <0.01* | 0.09 | 0.01* | 0.11* |
| | | Max | | | | 0.69 | 0.18 | 2.58 | 0.13 | 0.17 | 0.02 | 0.41 | 0.19 | 1.13 |
| | | Mean | | | | 0.18 | 0.05 | 0.60 | 0.02 | 0.03 | <0.01 | 0.06 | 0.03 | 0.21 |
| | 10-hour (ton/ac) | Min | | | | <0.01 | <0.01* | 0.01 | <0.01* | <0.01* | <0.01* | 0.14 | <0.01* | 0.07* |
| | | Max | | | | 0.51 | 0.18 | 2.02 | 0.07 | 0.02 | 0.20 | 0.67 | 0.14 | 2.20 |
| | | Mean | | | | 0.15 | 0.05 | 0.47 | 0.01 | <0.01 | 0.01 | 0.08 | 0.02 | 0.38 |
| | Available (ton/ac) | Min | | | | <0.01 | <0.01* | 0.02 | <0.01* | 0.01* | <0.01* | 0.16 | <0.01* | 0.15 |
| | | Max | | | | 0.94 | 6.27 | 3.59 | 0.17 | 0.17 | 0.35 | 0.75 | 0.26 | 2.23 |
| | | Mean | | | | 0.26 | 0.07 | 0.83 | 0.02 | 0.03 | 0.06 | 0.10 | 0.04 | 0.40 |
| 2 | 1-hour (ton/ac) | Min | NA | | | <0.01* | 0.01 | 0.01 | <0.01* | <0.01* | <0.01* | 0.02* | 0.01* | 0.12* |
| | | Max | | | | 0.63 | 0.10 | 1.49 | 0.06 | 0.08 | 0.25 | 0.79 | 0.04 | 0.84 |
| | | Mean | | | | 0.16 | 0.05 | 0.34 | 0.01 | 0.02 | 0.02 | 0.17 | 0.01 | 0.19 |
| | 10-hour (ton/ac) | Min | | | | <0.01* | <0.01 | 0.01 | 0.01* | <0.01* | 0.01* | 0.04* | <0.01* | <0.01* |
| | | Max | | | | 0.48 | 0.10 | 1.14 | 0.02 | <0.01 | 0.09 | 2.10 | 0.01 | 1.27 |
| | | Mean | | | | 0.13 | 0.05 | 0.26 | <0.01 | <0.01 | 0.01 | 0.31 | <0.01 | 0.29 |
| | Available (ton/ac) | Min | | | | <0.01* | 0.01 | 0.02 | <0.01* | <0.01* | <0.01* | 0.04* | <0.01* | <0.01* |
| | | Max | | | | 0.87 | 0.15 | 2.06 | 0.07 | 0.08 | 0.30 | 1.84 | 0.05 | 1.33 |
| | | Mean | | | | 0.23 | 0.08 | 0.47 | 0.01 | 0.02 | 0.02 | 0.35 | 0.01 | 0.34 |
| 3 | 1-hour (ton/ac) | Min | NA | | | <0.01 | <0.01 | 0.01 | 0 | <0.01* | <0.01* | 0.23* | 0.01* | 0.30* |
| | | Max | | | | 0.12 | 0.15 | 0.06 | | 0.02 | 0.01 | 0.79 | 0.44 | 1.07 |
| | | Mean | | | | 0.05 | 0.08 | 0.02 | | <0.01 | <0.01 | 0.25 | 0.12 | 0.22 |
| | 10-hour (ton/ac) | Min | | | | <0.01 | <0.01 | 0.01 | 0 | 0 | 0.01* | 0.09* | 0.01* | 0.20 |
| | | Max | | | | 0.12 | 0.12 | 0.04 | | | 0.01 | 0.37 | 0.76 | 1.36 |
| | | Mean | | | | 0.05 | 0.06 | 0.02 | | | <0.01 | 0.11 | 0.21 | 0.28 |
| | Available (ton/ac) | Min | | | | 0.01 | <0.01 | 0.01 | 0 | <0.01 | <0.01* | 0.19* | 0.01* | 0.28 |
| | | Max | | | | 0.19 | 0.21 | 0.08 | | 0.02 | 0.01 | 0.62 | 0.79 | 1.75 |
| | | Mean | | | | 0.08 | 0.11 | 0.03 | | <0.01 | <0.01 | 0.19 | 0.23 | 0.36 |

Appendix V: Shrub Sample Ranges

Sample ranges used to predict shrub loadings. R² values are the lowest calculated values from all developed regressions.

SAGEBRUSH STEPPE

| | Height (in.) | Longest Diameter (in.) | Perpendicular Diameter (in.) | Volume (in ³) | R ² |
|--------|--------------|------------------------|------------------------------|---------------------------|----------------|
| ARTRW8 | 8–57 | 7–75 | 3–57 | 61–125138 | 0.80 |
| CHVI8 | 10–28 | 9–48 | 5–42 | 332–18686 | 0.67 |

PINYON-JUNIPER

| | Height (in.) | Longest Diameter (in.) | Perpendicular Diameter (in.) | Volume (in ³) | R ² |
|--------|--------------|------------------------|------------------------------|---------------------------|----------------|
| ARAR8 | 4–19 | 9–34 | 7–31 | 164–9731 | 0.90 |
| ARNO4 | 3–24 | 2–55 | 2–35 | 5–19593 | 0.78 |
| ARTRV | 6–39 | 6–49 | 4–17 | 82–50995 | 0.93 |
| ARTRW8 | 2–55 | 3–63 | 2–51 | 9–75889 | 0.79 |
| CHVI8 | 4–51 | 5–73 | 4–31 | 62–61476 | 0.81 |
| PUTR2 | 5–75 | 4–146 | 4–91 | 38–516631 | 0.90 |

UTAH JUNIPER

| | Height (in.) | Longest Diameter (in.) | Perpendicular Diameter (in.) | Volume (in ³) | R ² |
|--------|--------------|------------------------|------------------------------|---------------------------|----------------|
| ARTRV | 6–64 | 8–78 | 8–45 | 215–96153 | 0.84 |
| ARTRW8 | 6–52 | 6–72 | 4–61 | 111–88538 | 0.86 |
| CHVI8 | 7–24 | 7–31 | 7–22 | 229–6460 | 0.74 |
| PUTR2 | 6–79 | 13–149 | 7–138 | 305–762917 | 0.97 |

WESTERN JUNIPER

| | Height (in.) | Longest Diameter (in.) | Perpendicular Diameter (in.) | Volume (in ³) | R ² |
|-------|--------------|------------------------|------------------------------|---------------------------|----------------|
| ARAR8 | 6–17 | 7–32 | 2–24 | 66–5870 | 0.84 |
| ARTRV | 8–51 | 7–66 | 6–62 | 194–104745 | 0.68 |
| CHVI8 | 7–29 | 4–38 | 2–33 | 43–14747 | 0.62 |
| PUTR2 | 7–89 | 10–119 | 5–101 | 268–556134 | 0.94 |

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